AN
EXTRACT
FROM THE
OBSERVATIONS
Made in a TOUR to ITALY,

BY

The Chevalier DE LA CONDAMINE,
Of the Royal Academy of Sciences at Paris, &c.

TRANSLATED

By a FELLOW of the ROYAL SOCIETY,

With an Alphabetical Index.

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EXTRACT OF A LETTER FROM THE AUTHOR TO THE TRANSLATOR.

...... I KNOW not how to return you due thanks for the honour you have done the Extract I gave into the Academy of Sciences of my Tour to Italy, by rendering its value in your tranſlation above that of the original, and at the ſame time exculpating the author from the many groſs blunders of a former tranſlation.

I preſume it may be now too late to alter the Title-page of your tranſlation: The running Title over the pages matters not much, but I would rather the Title were, *An Extract of the Obſervations made in a Tour to Italy*. Which Tour, &c. is really no more than an extract from my journal at large, wherein I had made a daily entry of every occurrence for eighteen months together, ten or twelve of which, I paſſed at the Duke de Choiſeul's, then our Ambaſſador at Rome.

In the extract delivered into our Academy, I thought proper to confine myſelf to ſuch matters as are objects of the Academy's inquiries; and the more ſo, as they have been the moſt neglected by travellers, who commonly give the preference to Antiquities, Polite Arts, Politics, and Commerce.

E R R A T A.

Page 37, laſt line but two in the note, for *apartments* read *compartments*.
Page 41, line 16, for *perferation* read *perforation*.
Page 50, laſt line but one, for *Acca* read *Acqua*.
Page 54, for the mark of the note *(a)* put *.
Page 124, line 20, after *copies*, put *of*.
Page 126, in the note, for *Tiſſet* read *Tiſſot*.
Page 162, in the note, for *Maſure*, read *Meſure*; and for *meridian* read *meridienne*.
In the Index, for *Analomy*, read *Anatomy*; for *del Lani* read *del Cani*; for *Opus Leſſelatum*, read *Opus Teſſelatum*; for *Veloet* read *Velvet*.

TRAVELS

THROUGH

ITALY, &c.

AS I ſet out upon travel chiefly for the recovery of my health, I did not chooſe to encumber myſelf with an apparatus of inſtruments, and conſequently could not, for the moſt part, make any other obſervations but ſuch as offered themſelves immediately to my view.

The amount of my collections, I muſt confeſs to be rather of the ſmalleſt, for a country ſo immenſely rich as Italy, in curioſities both of art and nature; however, I think I may ſave myſelf the trouble of framing an excuſe on that account. Their maſter-pieces of ſculpture, painting, and architecture have been deſcribed over and over with exquiſite judgment and accuracy; beſides, the plan I propoſed to myſelf, in a manner confines me to ſuch ſubjects as naturally fall under the cognizance of the royal academy of ſciences, and obliges me to exclude the polite arts, and the monuments of antiquity, unleſs in as far as they may be intereſting to mathematics, or natural philoſophy.

I left Paris the 28th of December, 1754. The 7th of the enſuing January, juſt as I was ready to embark at Lyons, to fall down the Rhone, that very rapid river was frozen over, and no longer navigable. Not many days after, I ſaw carriages paſſing over that branch of it, which waſhes the walls of Avignon: and I was informed, that the ſame thing had happened to the branch which ſeperates the city of Arles from Languedoc; an event ſo rare, that hiſtory affords few inſtances of the like.

It appears, that the froſt between 1754 and 1755, was ſharper in our ſouthern provinces, than in the northern parts of France. The liquor of two thermometers graduated according to M. de Reaumur's method, * one of ſpirit of wine, the other of quickſilver, expoſed to the air, deſcended at Lyons, the 17th of February, to 16 and 17 degrees below the point of freezing, which is about two diviſions lower than what the ſame inſtrument ſhewed

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* In the obſervatory of P. Beraud, profeſſor, of mathematics at the great college at Lyons, and correſpondent of the academy of ſciences.

ſhewed at Paris, in the famous winter of 1709. Another thermometer, of the ſame conſtruction, in a cloſet facing the ſouth, fell down to 22 degrees, whilſt at Marſeilles, in a latitude ſomewhat more north, but in a ſituation better defended from the northern winds, a like thermometer hardly fell ſo low as four degrees and two thirds below freezing, and that but once the whole winter, to wit, the 7th of January in the morning, at ſun riſing *: the ſame day the like inſtruments ſhewed ſeven degrees at Montpellier, and eight at Nimes.

Two feet depth of ſnow in the ſtreet of Montpellier, had never been known in the memory of man. The whole neighbouring country, as far as the eye could diſcern, was covered ſtill deeper

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* The Latitude of Montpellier is 43^{d}. $36\frac{1}{2}$; that of Arles 43^{d}. $40\frac{1}{2}$; that of Marſeilles 43^{d}. 18.

deeper the firſt days of February, reaching quite up to the axle-tree of my chaiſe. Languedoc and Provence afforded much ſuch a proſpect as the cordeliers of Peru. The verdure of the hedges and olive trees, which the winter could not ſtrip of their leaves, was quite hid under the ſnow, the only object that preſented to view. A Laplander might have fancied himſelf in his own country.

The famous *pont du gard*, the antique temple, commonly called the ſquare houſe, and the amphitheatre, all magnificent remains in and about Nimes, and equal to almoſt any thing that Italy boaſts of, can have no place, as I obſerved before, in this narrative: but can a traveller be ſo very inſenſible to the benefit of his fellow creatures, as to paſs over in ſilence, the beauty and emoluments of the high roads of France? endleſs pleaſure-walks! of ineſtimable advantage to the ſtate, and no leſs to the community! the glory of our age, country, and the preſent adminiſtration! I might perhaps juſtly add too, the envy of our neighbours, whoſe emulation it has excited to their own profit; witneſs the ſeveral works of the like kind I met with in travelling through Piedmont, Tuſcany, and the Eccleſiaſtical State; which yet, as I have heard, fall ſhort of the new grand road from Trieſte to Vienna, opened amidſt the mountains of Iſtria and Friouli, under the auſpices of the Empreſs-queen, with a magnificence worthy of the ancient Romans.

What can we deſire as a farther ornament to theſe our high roads, excepting only milliary works or boundaries, ſet up at equal diſtances; an ancient uſage, whoſe utility cannot be too highly extolled, A cuſtom eſtabliſhed among divers eaſtern nations, and worthy to be adopted throughout Europe. They began to introduce it in the Eccleſiaſtical State, by order of the late pontif Benedict XIV. An inſcription on a bridge near Rimini, with an elegant and laconic ſimplicity, intimates the deſign of theſe boundaries: *Viatorum ſolatio et commoditati.*

The ancients were ſatisfied with numbering their milliary ſtones, beginning from the capital. This cuſtom has been improved upon in the new terms erected along the high roads of Languedoc, by order of the ſtates of the province, and under the direction of M. Pitot, of our academy. The terms are ſhaped ſquare, four feet out of the ground: one of the angles is turned towards the high road, ſo as to exhibit two of the contiguous faces at once, whereby a paſſenger may ſee at the ſame time both thoſe faces. On one of them is expreſſed how many thouſand toiſes he has travelled ſince morning; on the other, how many more he has to travel before night; the ſum of theſe two numbers expreſſes the diſtance of the two places, which makes the ordinary days ſtage.

It would perhaps be worth while to copy the ancients in another example, reſpecting high roads. I have remarked, that among the preſent remains of the Roman roads, the joints of the large ſtones are never in the direction of the road; whence it comes about, that the wheels of carriages, not being able to inſinuate themſelves between the joints, have a leſs tendency to force the ſtones aſunder. *

As

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* A trial has been made of this in the neighbourhood of Paris: which has been found to be attended with

At my return from Montpellier to Avignon, where I made a ſecond ſtay; I found her royal highneſs the Margravine of Bareith, ſiſter of the king of Pruſſia, who paſſed the winter in this city. I could not but admire the knowledge and talents of this princeſs, uncommon with perſons of her ſex and rank. In the poſſeſſion of one of her ladies of honour, I ſaw a watch-caſe cut in facets, which reſembled poliſhed ſteel. upon examining it, I found that it was a kind of a mineral ſtone, great numbers of which are found in the ancient ſepulchres of Peru. They are plain and poliſhed on one ſide, courſe and conical on the other; and known by the name of the *Inca's looking-glaſſes.*

It

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with inconveniencies, ariſing probably from the ſmall ſize of the ſtones our roads are paved with, being no more than eight inches ſquare; but principally from the increaſe of labour required to beat down the ſaliant angles, in order to even both ſides of the cauſey.

It is a kind of pyrites, which ſtrikes fire with ſteel. There is nothing of metal in it, tho' it has all the appearances. It receives the fineſt poliſh, and is not liable to ruſt; which induces me to think it might be properly employed for the mirrors of reflecting teleſcopes; but though I brought pieces cut at Quito, fit to make buckles and buttons, I never could meet with any artiſts at Paris, who knew how to give a good poliſh to this ſubſtance; it has moreover, ſomething of a yellowiſh caſt, which muſt needs alter the colour of objects. There are mines of the ſame in Germany; and I learned that the watch-caſe which I ſaw was wrought at Bareith, where they alſo meet with various ſorts of coloured flints; among the reſt, a yellow one on a greyiſh ground, of which they make very beautiful cameas. As for the pyritic watch-caſe, the colour ſeemed inferior to thoſe I brought from Quito, and the poliſh not ſo lively.

I have ſince met with the Margravine, and the prince her huſband, at ſeveral courts in Italy. The preſents with which they were pleaſed to honour me, and their liberalities whereever they came, gave me frequent occaſions of admiring the ingenuity of the German artificers, in an art too much neglected among ourſelves, of working in hollow, and in relief, flints, agats, jaſpers, cornelians, emerald, and amethyſt block, and repreſenting by incruſtations of theſe ſtones, one upon another, flowers and animals in relief, and in their natural colours.

The vaſt quantity of marbles employed in edifices, was the firſt thing which ſtruck my view in Italy. Temples and palaces, covered with white marble, are very common at Genoa.

In the treaſury of the cathedral of this city has been preſerved, with the utmoſt veneration, for above ſix hundred years paſt, an hexagonal diſh, or rather bowl, which they give out to be of emerald. It has two ſmall handles, and is all of one piece: its longeſt diameter is fourteen inches and a half; the height five inches and nine lines; its thickneſs three lines. This monument is kept under ſeveral keys, entruſted in different hands: when it is ſhewn, which very rarely happens, and that only in virtue of a decree of the ſenate; the veſſel ſupported by a cord paſſed through both its handles, is hung about the neck of the prieſt appointed to ſhew it, and never goes out of his hands. It is by an ancient decree * of the 24th May 1476, forbidden under ſevere penal-

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* See a book entitled, *Il ſacro catino di ſmeraldo orientale:* p. 52.

penalties, to approach too near the holy diſh, *(il ſacro catino,)* and more ſtill to touch it with any ſort of metal. What are all theſe ceremonies and difficulties, but ſo many precautions againſt ſuch as might be deſirous of informing themſelves by ſome proof, as that of a file or a graver, if the material has really the hardneſs of emerald? Be this as it may, they have certainly an act to produce, by which it appears that the bowl was, upon a deliberation of the ſenate, in the year 1319, during the ſiege of Genoa, pledged to cardinal Luc de Fieſque, for a ſum of the value of 1200 marcs of gold; and that this ſum was repaid, and the pledge redeemed twelve years after. This fact ſhould ſeem to prove, that the great value of the material was not brought in queſtion at that time of day.

I cannot ſay what preſumption in favour of the material, may be drawn from one of its handles being cracked, nor how ſuch a proof ſuppoſed to have been made in the preſence of the emperor, Charles V. could evidence the legitimacy of the emerald.

The princes Corſini's, relations of pope Clement XI. whom I had the honour to accompany from Marſeilles to Genoa, having obtained from the ſenate the neceſſary decree for ſeeing the monument; I availed myſelf of this opportunity to examine it. I viewed it with all poſſible attention, as it was oppoſed to the light of a large flambeau. Its colour appeared to me of a very deep green. I could not perceive the leaſt particle of thoſe veins, ſtraws, clouds, and other impediments of tranſparency, ſo common in emeralds, and all large precious ſtones, even in rock cryſtal; but I could very clearly diſcern ſeveral little empty ſpaces, or air-bubbles, ſome round, ſome oblong, ſuch as are frequently found in melted glaſs, either white or coloured.

It can hardly be expected that a precarious notion of the twelfth century, ſhould be blindly reſpected in the eighteenth: and yet, I know not of any modern traveller who has controverted the point; and in Martiniere's geographical dictionary (the edition of 1740,) it is poſſitively affirmed, that *at Genoa there is preſerved a vaſe of ineſtimable value*. And I am the rather aſtoniſhed at ſuch an aſſertion, as my ſuſpicion is by no means a new one. The ſame may be fairly inferred from the expreſſions of William, archbiſhop of Tyre, four conturies ago, who ſays, that *at the taking of Cæſarea, this veſ-*

ſel became the property of the Genoeſe, for a handſome ſum of money, who fancied it to be emerald, and ſtill ſhew it for ſuch, and as no leſs than a miracle to travellers. * As for the reſt, if ſuch perſons there be, who may be diſguſted at theſe doubts; be theirs the taſk to diſpell them, if they are without foundation. I ſhould be far from going into ſuch a detail, but in hopes of getting a matter cleared up, which may be done with ſo much eaſe, without remaining any longer in obſcurity; or elſe, that even ſuch obſcurity ſhould ſtill ſubſiſt, may be the means of converting doubts into certainty.

I copied the deſign and dimenſions of the Genoa vaſe, which I produced be-

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* *Januenſes . . . . Smaragdinum reputantes, pro multâ pecuniæ ſummâ in ſortem recipientes . . . . uſque hodie tranſeuntibus . . . . vas idem quaſi pro miraculo ſolent oſtendere, &c.* Guil. Tyr. Archiepiſc. lib x. cap. xvi.

before the academy, from a work in 4to, publiſhed there in 1726. The author leaves a queſtion undecided which he propoſes to himſelf; whether the Genoeſe brought this precious rarity from the ſiege of Cæſarea in Paleſtine, in the year 1101; (as ſeems plain from this teſtimony of William of Tyre,) or from the ſiege of Almeria in Spain, taken by the Moors, in 1147? but he traces, with great erudition, through what hands the veſſel had paſſed, ſince the queen of Sheba made a preſent of it to king Solomon, unto the time it was uſed at the paſſover the night before our Lord's paſſion; of all which our author entertains not the leaſt doubt. As to the ſubſtance of it, he maintains it to be moſt certainly emerald; the argument he lays the greateſt ſtreſs upon being this, that the matter of the veſſel our Saviour made uſe of, in his inſtitution of the auguſt ſacrament of the Euchariſt, could not but be of the moſt precious kind. But ſhould this be admitted as a principle, I conceive it would lead the author farther than he intended it ſhould, by proving that the vaſe muſt certainly be diamond.

Since this I have ſeen in the poſſeſſion of M. Aſſemani, a Maronite prelate and keeper of the Vatican library, two tranſparent ſtones, one of them of a beautiful green. I was informed by him, that he had brought them from Egypt, and that they were taken from a large block which he had ſeen entire. The bigeſt ſtone was about ſix inches long, by three or four broad, and two, or two and a half thick; they paſs for emeralds. This I am ſure of, that they are ſo hard, that I could not ſcratch them with a graver; they are beſides very clean. Their colour is nothing near ſo deep as that of the bowl at Genoa; though they are conſiderably thicker: they are all over equally tranſparent; in a word, I could not diſcern the leaſt blemiſh in them, a circumſtance very uncommon for emeralds, even of a moderate ſize; nor did I perceive any air-bubble in them, though ſo common in melted glaſs. Theſe two fragments are nothing in compariſon to a ſtone of the ſame colour, weighing above twenty pounds, of a quadrangular form, kept at the convent of Reichenau, near Conſtance: it was a preſent of Charlemagne to that abbey. It is given out, that the Nuns have made a conſiderable ſum of a few fragments of it, though they could not obtain from the emperor Charles VI. permiſſion for ſelling the reſt. This ſtone I never ſaw, but the ſhape and dimenſions of the block, are given in Keyſler's Travels through Germany, printed at Hanover, 1740.

We do not know that any emeralds are brought us at this time, but from America; and particularly from the new kingdom of Grenada. Hiſtorians pretend, that the Spaniards, when they diſcovered the new world, found them in great quantities at Puerto-Viejo, and Manta, on the coaſt of Peru, in the province of Quito. It is very unaccountable, that not ſo much as a tradition of any ſuch thing now ſubſiſts in thoſe parts; this I can myſelf affirm, after all poſſible enquiries there. The river of emeralds which I aſcended, even to its ſource, the Indian hamlet ſituate cloſe by the mouth of it, the little mountain near its banks, where it is reported the old mine was, in a word, the whole province whereof the late Don Pedro Maldonado, my aſſociate in my voyage down the river of Amazons, was governor, theſe ſeveral places ſtill retain the name of Eſmeraldas, but nothing more than that name. They exhibit not the leaſt mark of any old work; and if there ever was ſuch, the memory of it is entirely aboliſhed among the natives of the country.

We are ſo little acquainted with the natural hiſtory of the emerald, and of the difference between the oriental and occidental ones, that Tavernier will not admit any ſuch diſtinction; ſo little is there known for certain, from what places the ancients procured them. What Herodotus and Pliny ſay of the prodigious ſize of ſome of them, ſeems ſo far from being probable, that it were to be wiſhed, we could only be ſure from what part of the world thoſe few large ones we now have in Europe, were really brought.

The whole range of rocks on the Genoeſe coaſt, conſiſts almoſt entirely of ſlate or marble. A little farther, about a league from the ſea, in the principality of Maſſa, is the little city of Carrara, a new Paros, where they raiſe that fine ſort which we call the Carrara marble, of the whiteſt hue, and the fiteſt of all for ſculpture.

In my paſſage from Genoa to Lerici in a felucca, I entered the gulph of Specia, where I ſaw a ſpring of freſh water in the midſt of the ſea. This gulf, on the coaſt of which maybe ſeen the ruins of the ancient city of Luna, deſtroyed by the Saracens, forms the fineſt and largeſt harbour of the Mediterranean, and perhaps, of the whole world. Silius Italicus mentions it in a particalar manner:

- - - - - - - - Quo non ſpatioſior alter
Innumeras cepiſſe rates, et claudere pontum.
Lib. viii. ver. 481.

In its circuit and channels are many different ports: two fleets of men of war may lie at anchor there, without ſeeing each other.

The harbour of Leghorn, its advantageous ſituation for trade, and the protection of the great dukes de Medicis, have in the ſpace of two centuries, improv'd a poor little village into an opulent city, with forty thouſand inhabitants; notwithſtanding it is ſituated on a deſart, marſhy, and unhealthy coaſt, as are the moſt part of the maritime towns of Tuſcany and the Eccleſiaſtical State. This example ſhews, that by aſſiduity, pecuniary encouragement, and a ſettled ſyſtem of government, (conditions which rarely concur) the worſt of countries may become populous, cultivated and fertile.

The ſubterraneos excavations which public works require, frequently prove a fertile ſource of diſcoveries in the foſil way. Thoſe carried on for the port of Leghorn, ſerved greatly to enrich the cabinet of the chevalier de Baillou, which the emperor purchaſed, and had it removed to Vienna ſome years ſince.

His imperial majeſty ſends naturaliſts and deſigners into all parts of the world, to make new collections. In my way to Marſeilles I received a viſit from a young Dutch phyſician, who with two aſſiſtants, was juſt going to embark for Spaniſh America; their whole buſineſs being to increaſe the furniture of the emperor's cabinet at Vienna.

His imperial majeſty's taſte for natural hiſtory is ſo keen, and ſo ſeconded by the zeal of his ſubjects, that his cabinet, formed in a ſmall number of years, according to the report of a moſt exquiſite judge in ſuch matters, exceeds, for the mineral part of it, the two moſt celebrated collections in Europe put together, I mean that of the king of France, and the Britiſh cabinet, purchaſed of the heirs of Sir Hans Sloane, by the government.

Tuſcany abounds in minerals and foſſils of every kind, and collections of natural hiſtory are more common there, than in the other parts of Italy. The marquis Ginori, governor of Leghorn, has been, for ſeveral years, upon a conſiderable work on the earths, ſtones, minerals, and all foſſils of the country. He was pleaſed to ſhew me tables, of the reſults of his numerous experiments on a variety of ſubſtances, vitrifiable and calcinable, pure and mixt, in different proportions, committed to the action of fire, or acted upon by divers diſſolvents. In the manufacture of porcelane carried on at Florence, at his ſole expence, they execute pieces of a vaſt ſize. I ſaw there ſtatues and groups as big as half life, modelled after the fineſt antiques. His furnaces are conſtructed with great art, and lined with bricks of his own porcelane, the paſte of which is excellent, and breaks after baking, with a grain that has every mark of that of the beſt Chineſe porcelane. The only thing which ſeems to be wanting to the Florentine porcelane, is a ſomewhat whiter glazing; and, probably, it would not be without this perfection, but that the marquis makes it a point to uſe no other materials beſides ſuch as the country produces *.

In a cabinet at Leghorn, I ſaw a fragment of the jaw-bone of an elephant, of twenty pounds weight, petrified to agat. I have in another place ſpoken of a grinder (I can't ſay of what animal,) that weighed two or three pounds, likewiſe converted to agat. This was found at Tucuman, in South-America, where there is no ſuch thing as an elephant. It made part of a conſiderable pacquet, of which I ſtill lament the loſs, as it contained a conſiderable number of

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* Since this was written the marquis is dead, and I have not heard into what hands his papers, and tables of experiments are fallen.

curioſities which I had intended for the king's cabinet, directed it to the care of the late M. du Fay, of our academy, and put it on board a veſſel at Callao, the port of Lima, bound for Panama, the 2d of May, 1737 *.

At a private family at Leghorn, I ſaw three little animals, which, in Italy, they call Carthaginian moles. They ſomewhat reſemble ſquirrels: Their fore feet are very ſhort, and they uſe them as hands, and go by hops on the hind feet only. It appears that Ariſtotle and Theophraſtus knew this creature: It is deſcribed at large in the Tuſcan magazine of 1755, a periodical work, publiſhed every month under the direction of

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* See the note at page 104 of the *Journal Hiſtorique du Voyage à l'Equateur*. Au Louvre, 1750. 4to.

the Abbé Venuti, provoſt of the church of Leghorn, and foreign aſſociate of the academy of belles-lettres at Paris, who did me the favour to entertain me at his houſe, whilſt I reſided at Leghorn.

I arrived at Piſa the 27th of March 1755. That night there was an eclipſe of the moon. M. Perelli, profeſſor of aſtronomy in the univerſity of this city, communicated to me the phaſes he had obſerved of it, with ſome other obſervations, as the latitude of the obſervatory at Piſa, 43 d. 43 m. 1 ſ. and the obliquity of the ecliptic in 1753, 23 d. 28 m. 19 ſ.

Piſa has loſt much of its ancient ſplendor; yet ſtill there are to be ſeen temples, towers, and a very fine bridge of white marble; not to mention columns, and other antient monuments brought from Greece. The cathedral, an immenſe edifice, is caſed over with the ſame marble. The chapel of St. Epina is built entirely of this material, out of the ſavings of a ſingle Mendicant friar: The round tower near the cathedral is of the beſt Carrara marble. This tower, decorated with ſeven ranges of pillars, one above another, beſides that of its turret, has been built near ſix hundred years: It is about four toiſes in diameter; it is, moreover, very famous for its inclination, which ſeems, at firſt ſight, to threaten the deſtruction of it. Some have pretended, that it was originally, and on purpoſe, built in this manner. This ridiculous conjecture, adopted in Martiniere's dictionary, may be diſproved by the ſlighteſt attention. All the lintels of the doors are broken, and none of the courſes of the ſtones are horizontal:

The greater part of the towers at Piſa hang in the ſame way as this: Several of the ſquare pillars and ſpurs of the cathedral, are inclined in the like direction; which ſhews, that the ground on which theſe edifices were erected, before piling was introduced in laying foundations, has ſettled towards the ſouth, that is, towards the river.

One evident proof that the ſoil of Piſa is not ſolid, is, that the royal obſervatory of this city, a very fine one, built not above ten years ago, on the foundation of an ancient tower, was ſunk in March 1755, more than a Paris foot. This M. Perilli, the director of it, aſſured me of.

I meaſured with a plumb-line the height and the inclination of the tower at Piſa: It wanted thirteen Paris feet of being upright, counting from the baluſtrade upon the platform, to the foot of the upper turret, where the bells hang. I found the height of the platform above the level of the place, or the ground-floor of the cathedral 133 feet, to which adding 27 feet for the height of the turret, (which inclines leſs than the body of the tower) 8 feet for the depth of the ditch, and about 2 feet, which I ſuppoſed the line to have ſhrunk ſince the operation, being not charged with any weight, we ſhall have 170 feet for the whole height of the tower on that ſide where it ſlants moſt; ſo that if it were brought upright, it would be near 172 feet high. This height is not the half of that of the Aſinelli tower at Bologna, which is only of brick, and of a ſquare form: Its baſe ſeems much narrower than that of the tower at Piſa. The Aſinelli tower is reckoned 371 Rhinland feet high, which make about 358 of our feet. The towers of Notre-dame at Paris are but 204 feet. Another tower at Bologna, called the Gariſenda, of the ſame materials and diameter, to all appearance, as the Aſſinelli tower, ſeems to lean no leſs than the tower at Piſa, but the top part of the Gariſenda is either tumbled down, or demoliſhed, to preſerve the reſt.

Upon the marble bridge at Piſa before-mentioned, there is obſerved every three years a very ſingular cuſtom, of which I happened to be an eye-witneſs. Its origin can hardly be traced in the remoteſt antiquity *. Six hundred and forty athletic fellows divided into troops, armed in gilt

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* See a book entitled, *l'Oplomachia Piſana,* in 4to. Lucca, 1713.

cuiraſſes and helmets, meet and diſpute the paſſage of the bridge with great clubs : They often knock one another into the river, where boats are ready to receive and ſave them. The bloodineſs of the combat often produces a tragic ſpectacle. I ſaw much work cut out for the ſurgeons, the particulars of which come not within my plan.

From Piſa I returned to Florence, where every thing engages a ſtranger to protract his ſtay, and where, accumulated with the favours and regards of the family of Corſini, I occupied the largeſt and moſt ſuperb palace of the city, in the abſence of its maſters, who, ſince the pontificat of Clement XII. have held their uſual reſidence at Rome.

When the emperor transferred the cabinet of natural hiſtory to Vienna, which he had purchaſed at Florence, that prince left in this city a prodigious quantity of vaſes, toys, and works of art, ancient and modern, of the moſt precious materials, and richeſt execution, which made, and ſtill makes part of the immenſe collection of antiquities and curioſities in the gallery of Medici, where this only kind of rarities fills many vaſt caſes. The deſcription of this gallery has been long ſince promiſed the publick. The chapel of St. Laurence, deſtined for the ſepulture of the princes of the houſe of Medici, where the moſt precious marbles are hardly admitted, contains in its lining alone, which is not yet finiſhed, magnificent impannelments of large pieces of jaſper, porphyry, lapis lazuli, &c. of which we ſee no other than ſmall ſingle fragments in the richeſt cabinets of Europe.

We all know it is with little priſms or cubes of theſe hard ſtones, artificially ſet together in a prepared cement, that the ancients painted ornaments, flowers, animals, and even human figures, in unalterable colours; which they called *opus teſſelatum*, *opus muſivum*, and the moderns, moſaic *. One of the moſt elegant monuments of this kind, not yet publiſhed, is a pavement diſcovered even with the face of the ground, at Fraſcati, in a houſe belonging to the Jeſuits, called La Rufinella, which they tell you is a part of Cicero's Tuſculum. There is a buſt of Minerva, armed with a helmet and cuiraſs, much bigger

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* See the work of M. Furietti (now a cardinal) *de Muſivis*, in 4to. Rom. 1752.

ger than nature, executed in a moſt grand manner. Chymiſtry, by giving no leſs durable colours to glaſs, often more vivid than thoſe of hard ſtones, and of all degrees of ſhades, furniſhed the operators of the middle age with the means of perfecting this fine art *. It is now cultivated at Rome with ſtill more ſucceſs, and has been for a century paſt, as appears by the immenſe works of this kind executed in the church of St. Peter. All its arches are already, or ſoon will be, lined with it: All the pictures of the chapel altars will be executed in the

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* In ſeveral antique moſaics, are ſometimes, eſpecially in the borders, bits of coloured glaſs; but if we will not allow that this is a method of repairing leſs ancient than the work, it muſt, however, be acknowledged that theſe pieces have no gradation of ſhades, as in the modern moſaics; and they form only apartments of edgy colours. The ſubſtances of the ancient moſaics which repreſent human figures, are on marble, brick or flints, of ſeveral colours.

ſame manner; and thus is found out a way of making a portrait as laſting as a ſtatue, and of perpetuating maſter pieces of painting, which otherwiſe two or three centuries would be ſufficient to deſtroy.

Attempts have been made to improve the moſaic of hard ſtones, by ſubſtituting in its ſtead a kind of cut, or in-laid work. This inlaying conſiſts not of little ſimilar pieces, ſuch as priſms or cubes in the ordinary moſaic. The new incruſtation is formed of large unequal pieces, cut out as the contour of the object to be repreſented requires. The firſt eſſays were repreſentations of flowers and fruits, and ſometimes of birds and inſects, by in-laying thin pieces of agat, jaſper, lapis luzuli, cornelian, and coloured flints. We have, in ſome great houſes, and royal palaces, in

France, fine tables wrought after this faſhion in the laſt century: But at Florence, Rome, and Naples, they have ventured to introduce human figures.

This way of working has ſome advantages over the moſaic. The vaſt multitude of joints and angles inevitable in an aſſemblage of ſmall cubes and priſms is greatly diminiſhed tho' what is hereby gained for the correctneſs of the deſign, as the inlaid piece conforms itſelf exactly to the out-line of the drawing, and the colours retain their purity, without being ſullied by numerous joints, is perhaps over-balanced for want of a juſt degradation of the tints, which the moſaic can eaſily give. In the moſt modern pictures where human figures are repreſented, the difference is ſtill more ſenſible: a ſtone ſhaped to the out-line of the figure, has a neater look, and the deſign to a near view appears exact; but the fleſh and draperies, conſiſting of broad inlaid pieces, cannot exhibit the demi-tints. Pictures of this kind, even of mere architecture, though taking at firſt ſight, are not exempt from the aforeſaid defect.

The meridian of St. Petronio, drawn at Bologna above a century ago, by the famous Dominic Caſſini, is known all over Europe; but few have heard that the grandeſt monument of this kind has exiſted for near three centuries in the cathedral church of Florence, and that Paul Toſcanelli was the author of it.

During my abode in that city, I, together with father Ximenes, profeſſor of mathematics, and geographer to his Imperial majeſty, examined every part of this ancient meridian, then buried in profound oblivion *. The great ſolidity of the braſs plate, deſigned for the centre of the gnomon, which is ſeven lines thick, let into and fixed in the cornice of the lantern which crowns the dome, ſupported by two ſhoulders likewiſe of braſs, perforated judiciouſly with a conical chamfer ; the projecting edge of the ſtone (where the plate is ſealed) and the notch in that edge, for permitting the plate to be fully illuminated by the noon-tide ſun ; its height of more than 277 Paris feet above the pavement of the church ; the diameter of the perferation leſs than the two thouſandth part of its height ; the circular marble fixt in the pavement of the church for receiving the projected image of the ſun at the ſummer ſolſtice ; the ob-

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* See p. 41. of the Hiſtorical Introduct. to the work cited in the next note.

ſervation which was made on this marble in 1510, atteſted by an inſcription ſtill legible; all theſe plainly indicate the capacity and noble views of the author of this work. I with regret reflected that ſo glorious a monument of modern aſtronomy, conſtructed at a time when the arts and ſciences had not yet triumphed over barbariſm; ſhould continue in obſcurity, and remain unemployed in an age ſo enlightened as ours; upon which I made ſome repreſentations to count Richefort, preſident of the council of the regency of Tuſcany, who ſeemed to hear me with much attention: In conſequence of which, I heard ſome little time after at Rome, that his imperial majeſty having been informed by that miniſter of the importance and utility of the meridian of the church of Florence, for the progreſs of aſtronomy, had been pleaſed to order that no expence ſhould be ſpared for its reſtoration. P. Ximenes, charged with the execution of the emperor's orders, has ſince moſt ſcrupulouſly verified every part of this ancient gnomon, retraced and rectified the meridian, and adjuſted the level of it, has made new ſolſtical obſervations, and has finally concluded from their compariſon with the ancient ones, that the obliquity of the ecliptic was leſs by one minute and ſixteen ſeconds in 1755 than in 1510. He has given an account of all his operations in a work in quarto now in the preſs *. In 1756 he ſent me to Rome a M. S. of his firſt obſervations, which he deſired I would lay before the academy; I did ſo, and they were pleaſed to admit him into the number of their correſpondents.

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* It has ſince been publiſhed under the title of *de Vecchio è nuovo gnomone Fiorentino. Firenze*, 1757.

All the dimenſions of the new meridian were taken in Paris toiſes, feet, inches, and lines. The French meaſure, and that of Florence, graven upon braſs, are let into the pavement of the church, directly under the centre of the gnomon; they were carefully taken off from the iron half toiſe, which I took with me to Italy, and that was taken from the toiſe which M. de Mairan made uſe of in his experiments on the pendulum *.

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* I at that time ſuppoſed, with M. de Mairan, (See *Mem. de L'Ac. des Sc.* 1735, p. 157; and 1747, p. 499 and 500) that his toiſe was equal to the iron rule which we carried to Peru in 1735, to be uſed in meaſuring the terreſtrial degrees, a model of which I left at the academy. This model and our toiſe had been compared together, and found equal, at one of our aſſemblies. The next year, 1736, the depoſited model was carried to Lapland by M. de Maupertuis and his aſſociates, who uſed it in the meaſure of that degree of the meridian which is cut by the polar circle. But M. de Mairan's toiſe has ſince been found to be ſhorter than ours by about the tenth or twelfth part of a line. However this merits a further examination.

In like manner I depoſited at Rome the length of the ſame toiſe on a proper part of the ſtone balcony of the front of the French academy of painting, ſculpture and architecture. The iron toiſe, ſent by M. de Mairan to the fathers Maire and Boſcowich, to be uſed in their meaſure of a degree in the Eccleſiaſtical ſtate, is exactly compriſed (when de Reaumur's thermometer ſtands at 10.14) between the vertical and parallel faces of two clipping pieces, projecting about half an inch, and ſet exactly ſquare to two porphyry cylinders which are ſealed into the balcony ; and ſo form a ſtandard or gage for cutting a rule, whether of wood or metal, to the juſt length of a toiſe. If the ſame meaſure be required to be taken between the points of a beam-compaſs, inſtead of bringing thoſe points to the edges of the clippers, which would be difficult and too uncertain, it will be better to adjuſt the points to two very fine and parallel lines drawn with a diamond on the horizontal ſurface of the two porphyry cylinders.

It was but a very little before the preſent century; I may properly ſay within theſe thirty years, on account of new experiments on the length of the ſimple pendulum, and new meaſurements of degrees on the ſurface of the earth, that a ſcrupulous preciſion was found neceſſary, in the verification of the inſtruments employed in meaſuring. The ſtandards of the old meaſures were divided into inches only, without any ſmaller ſub-diviſions. What matters it indeed if a fathom or an ell, intended to meaſure a wall or a piece of cloth, ſhould happen to be a line longer or ſhorter than it ought to be. In common ſurveying, a few inches are commonly neglected, and ſometimes alſo in caſting up the contents of maſonry. Is it therefore to be thought ſurpriſing, that there ſhould ſubſiſt an uncertainty of a line or more as to the length of ſuch a meaſure as the ancient cubit, or the Greek or Roman foot. To direct our inquiry into the length of the latter, there is no legitimate model left, and if there were, could we be certain that the length of this foot has not varied at different times? Were the meaſures of the ancients better ſecured againſt accidental changes than the commoneſt of our modern ones, the toiſe and ell? It was found neceſſary to reform the former in 1669, by making it five lines ſhorter, and what is perhaps more particular, there remains no mark of this reformation beſides the bare mention of it in M. Picard's little tract *de Menſuris* in tom vi. of the *Anc. Mem. of the Acad.* p. 536, and a word or two in the ſame author's *Meaſure of a Degree*. All who have ſince ſpoken of it, only cite that academician. It is true, that about two years ago, might be ſeen the old falſified iron ſtandard, let into a ſtone pillar near the ſtair-caſe of the court of the grand chatelet; and the new ſtandard, alſo of iron, may be ſeen at this time, ſealed into the inner column of the arcade which leads to the ſtair-caſe. It has not been yet ſtolen away, as was the old one in 1762; but, what would hardly be believed out of France, no inſcription was ever properly fixed upon or near either of them, to tell what they were, nor why, and at what time they were there placed. Moreover that which ſtill remains, alike in this particular to the other which no longer exiſts, is of ſo groſs a fabric, and the angles of the two ſaliant clipping pieces which terminate the rules ſo very much blunted, whether by frequent uſing, injuries of the air, or other accidents,

cidents, that two toiſes gaged by this ſtandard, and that by the ſame perſon, could not be equal, but by great chance *.

Since the reform made under M. Picard's inſpection, whoſe name promiſes the greateſt exactitude, he himſelf erred near ſix toiſes in the length of the fundamental baſe of his work for the meaſure of a degree; and his error is a proof that the toiſe he made uſe of in the menſuration of his baſe, was near a line too ſhort †.

M. de la Hire found the Paris ell ſo different among the different companies of merchants, that ſome of

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* See the new project for an univerſal meaſure. *Mem. de l'Acad. des Sc.* 1747, p. 500.

† This error, diſcovered in 1740, was verified in 1757, by new meaſures of the commiſſaries of the academy. See *Meridienne de Paris verifiée Sect. I. p.* 33, &c. *Mem. de l'Acad.* 1754, p. 185.

them, as he ſays, made it four inches ſhorter than others *.

The ell, by the edict of Paris 1557, was fixed at three feet, ſeven inches, and eight lines; and yet the iron ſtandard of that meaſure, depoſited in 1554 at the merchant's hall, was three feet ſeven inches and near eleven lines of the toiſe reformed in 1668. This affair was not thoroughly cleared up till 1745, by the examination and verification made by Meſſrs Camus and Hellot of the academy, who were authoriſed by the miniſtry †. They found this ſtandard very coarſely wrought, and worſe divided, by broad, unequal and oblique ſtrokes, in a word, too long by more than two thirds of a line, at the entrance of two ſaliant pieces, made for receiving the meaſures to be examined.

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* *Mem. de l'Acaa.* 1714. p. 398.

† See *Mem. de l'Acad.* 1746. p. 607, &c.

After the detail I have given, can it be thought ſtrange, that among the ancient feet preſerved at Rome, there ſhould be found a diſagreement of above a line of ſome from others? It is near a century ſince Meſſrs. Picard and Azout gave the proportion of the Roman to the Paris foot, as they had concluded it, the one from a compariſon of ſeveral teſtimonies, the other upon his own obſervations made upon ſome ancient feet cut in ſtone. Since that time ſeveral others have been diſcovered at Rome, both in ſtone and metal. They all differ from one another, and have been differently valued for three hundred years paſt, by learned men, curious travellers, and antiquaries. Theſe, for the moſt part, have made uſe of their own national meaſures, whoſe proportions to ours are not perfectly well fixed *; and

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* See *Mem.* 1747. *p.* 498.

each employed a foot, the authenticity whereof had never been verified. On the one hand the ſeveral models differ ſometimes a line or more, on the other, the ſeveral obſervers do not agree ſometimes within two or three lines in the length of the ſame foot *.

I might claim an equal right with any one elſe to relate in this place my own particular meaſures of the ſeveral known ancient feet, and from thence deduce a new determination of the length of the Roman foot ; which yet I could not pronounce to be the

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* The foot of Ebutius, according to Fabretti, is 133 $\frac{1}{3}$ lines ; according to P. Revillas, 131 $\frac{1}{2}$ according to the Abbé Barthelemi and P. Jacquier in 1756, 130 $\frac{2}{3}$ only, near three lines ſhorter than Fabretti's. Theſe make the feet of Statilius and Coſſutius to be equal. M. de la Hire eſteems them to differ near half a line. See the diſſertation of the Acad. of Cortona, Tom, iii. p. 125. *Mem. de l'Acad. des Sci.* 1714. p. 395. *Mem. de. l'Acad. des Belles Lettres*, Tom. xxviii. p. 609.

beſt, and might ſerve only to multiply uncertainties. I thought my time would be better employed in conveying the originals themſelves to Paris, or for want of them their moulds, which I procured to be caſt upon the four ancient Roman feet preſerved in the capitol; namely thoſe of Statilius, Coſſutius, Ebutius, and another found near the Villa Corſini, preſented to the cabinet of the capitol by the marquis Capponi, whoſe name it bears. I ſay nothing of ſuch portable feet of braſs or iron, as verdigriſe, ruſt, or frequent uſe may have rendered too ſhort, concerning myſelf with thoſe only which are cut in bas relief. I took the precaution to ſuffer the plaſters to dry on the original reliefs, that the moulds might retain their juſt lengths *. Since I read this memoir,

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* It were to be wiſhed, that in ſuch a caſe, there could ſome ſubſtance be uſed for a mould, as fit to receive the impreſſion as plaſter; but more ſolid and capable

moir, I have depoſited the ſaid moulds with M. l'Abbé Barthelemi: So that for the future theſe four meaſures may be examined and compared with one another at Paris as well as at Rome, and the ſame inferences made thereupon, as if the originals in their preſent condition were before the eyes of the examiner. In particular, that at firſt, and more manifeſtly ſtill upon examination, he will be convinced as I am, 1ſt. That the ſculptures of theſe feet, whether on ſtone or marble *, was never delicate enough, even before the edges and angles of the reliefs had been worn off and blunted by time, ever to have given teſtimony that theſe monuments

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capable of acquiring, at leaſt in time, a ſuperior degree of hardneſs. Perhaps it might not be impoſſible to find out ſuch a thing, which would well merit the reſearches of ſome lover of arts, more ſkilful than I am.

(a) The Ebutian foot is not carved on marble, but upon a ſtone called *peperino*, of a courſer and more porous texture than marble.

ments were to be regarded as faithful ſtandards of the ancient foot. And indeed, where is the probability that a ſculptor, or rather a ſtone-cutter, employed on a courſe carving of a tomb-ſtone, ſhould pretend to exhibit, or even could if he aimed at it, the exact length of the Roman foot, by a mere ſymbol intended to denote the profeſſion of the architect named in the epitaph. 2d. It is ſtill more impoſſible, in the condition theſe pretended models appear at this time of day, to know certainly what was their primitive length. 3dly. That they are viſibly unequal to one another, and conſequently, by their means there can be no ſuch thing as coming at a more exact value of the Roman foot, than of that of Paris, by undertaking to fix its length from ſuch wooden joint rules as workmen commonly uſe, which often differ one from another above half a line; and indeed theſe latter are in the main more conformable among themſelves, than the ancient foot of the capitol.

In all appearance the fitteſt means to decide the queſtion concerning meaſures, would be a plan of ſome ancient city, where ſeveral antique ſtructures ſtill remain, or at leaſt the veſtiges of them. In 1573 were diſcovered in the ruins of a temple of Romulus, now the church of St. Coſma and St. Damianus at Rome, the remains of that city engraved upon marble in the reign of the Emperor Septimius Severus. Theſe fragments aſſiduouſly collected at firſt, and ſoon after as much neglected, remained in oblivion for near two centuries in the Farneſe palace, till in 1742 pope Benedict xiv. requeſted them of his Sicilian majeſty. What could be found of them, was brought to the capitol, and diſtributed into ſix and twenty tables, which now line the walls of the grand ſtaircaſe.

Upon viewing this monument, to which is added a braſs ſcale, ſealed into the firſt table of the fragments, and intended to meaſure diſtances on the plan, I conceived no ſmall hopes; and my firſt care was to examine the exactneſs of the ſcale. The inſcription made in 1742, imports that the ſcale was deduced from the compariſon of the ancient monuments now in being: *Tabulæ I. adjecta eſt compendiaria pedum antiq. rom.* lxxx. *menſura, ex eorumdem fragmentorum collatione cum veteribus edificijs deprompta.* I diſcovered however, by my firſt eſſays towards the verification, that the ſcale but ill agreed with the meaſure of the moſt clearly deſigned monuments. The author of the inſcription, as well as the perſons who directed in the diſtribution of the fragments, were

dead.

dead *. After many enquiries, I at length diſcovered who it was that conſtructed the ſcale of the plan: The Sieur Nolli, author of the beſt and largeſt plan we have of modern Rome, magnificently engraved in 1748. I learned of himſelf what were the means he had taken for forming his ſcale. I perceived by a further examination, the ſlender grounds he had for relying on his conjectures, and he was of the ſame opinion. Waving all other proofs, it may ſuffice to obſerve, that the ſcale he annexed to the plan, is ſix inches and near two lines of our foot, and that it is the meaſure of a diſtance of eighty ancient feet; whence it ſhould follow, that the whole plan out of which theſe fragments were collected, was near 100 Paris feet in diameter †, which is impoſ-

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* The Marquis Capponi and P. Revillas.

† At Rome from the Flaminian gate (now del Popolo) to the Capenan gate (now St. Sebaſtian's) is above

impoſſible, ſince the whole diameter of the temple, of which this plan was the pavement, and which I meaſured myſelf, is no more than forty-four feet eight inches. In ſhort, the more cloſely the beſt preſerved fragments of this antique plan are examined, (I ſay the beſt preſerved, for a great number of them having been either loſt or diſperſed ſince it was diſcovered, have been replaced from the graving of Bellori, which takes up ſcarce one half of the plan) the ſtronger will be the conviction that the coarſeneſs of the execution, and the inaccuracy of the work muſt needs render it abſolutely uſeleſs in ſatisfying the queſtion about the ancient meaſures. I ſhall omit going into the particulars of the ſeve-

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above 3000 paces, or more than 15000 ancient feet; and 80 feet being the 187-½th part of 15000 feet, this diſtance of 15000 feet would have been meaſured on the ancient plan by 187-½th, the length of the ſcale anſwering to more than 96 *Paris* feet.

ral proofs I could alledge, as they would be enough to furniſh out a ſeparate memoire ; and ſhall only add, that had I any ſcruple remaining, I ſhould have been confirmed in my opinion by that of the Abbé Bartholemi, whoſe particular inquiries and ſome new obſervations we afterwards made together at Rome, have brought to the ſame concluſions. Since my return to Paris, I have ſeen that M. Piraneſi has formed the like judgment of the ancient plan, almoſt all the fragments of which he has graved a new in the great work lately publiſhed on the Roman antiquities, in four volumes large folio *. It affords a kind

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* The ancient plan is in itſelf ſo defective, that it is of no great conſequence to obſerve here, that the gravings of Bellori are far from exact, and ſeem to have been made from proſpect views. The diſtances and number of the columns of temples and other buildings, the proportion of lines, the opening of angles, ſeldom correſpond to the originals. The

kind of conſolation for the preſent periſhing ſtate of this monument, that it has little intrinſic value, and could not, had it been preſerved entire, be of any manner of uſe in the verification of the ancient meaſures.

It is highly probable that the fundamental dimenſions of ſome grand edifice, not confined under ground, ſhould contain a round, or at leaſt an integral number of ſmall meaſures; that the two axes, for example, of the ellipſe of the Coliſeum, the diameter of the Pantheon, the front of the baths of Diocleſian and Caracalla, contain rather an integral number of Roman feet, than a fractional one. This reflection, which ſo naturally offers, ſuggeſted to me a ſeemingly

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The ſame may be ſaid of M. Pianeſi's gravings, viſibly copied, and negligently too, from thoſe of Bellori, doubtleſs becauſe he judged it would be loſs of time to aſpire at more exactneſs.

proper means for determining the true length of the ancient Roman foot. With this view I took, as exactly as poſſibly I could, ſome capital dimenſions of the moſt famous monuments now ſubſiſting at Rome, and I tried which of the meaſures aſcribed to the Roman foot, would divide the total length, without any remainder: But this expedient, which has not even the merit of novelty *, did not anſwer my expectation; and every thing rightly conſidered, I perceived that I could not hope for a greater degree of preciſion from it, than from the meaſure of one ſeparate foot. This, I believe, has not been yet taken notice of, though it be really the caſe, which I prove thus:

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* See M. Picard *de Menſuris*, before cited (*Ançiens Mem. de l'Acad. des Sc. Tom.* vi. *Mem. de l'Acad.* 1714, p. 396. I ſhall however give the reſult of my attempts at the end of this narrative, with the ſeveral values of the ancient Roman foot deducible from them.

In the firſt place, this method is not exempt from difficulty. I ſuppoſe that the interior diameter of the Pantheon, whoſe circuit is circular, to be 150 ancient feet: It ſhould be at the firſt layer or range of ſtones, according to all appearance, that the diameter has ſuch round number of ancient feet, and not at the height of the level with the ground; and yet it cannot be actually meaſured but at that height. 2dly, Let us ſuppoſe at a venture, that the diameter ſhould be meaſured at the level of the ground; one would then be apt to think that the meaſure aſſumed ſhould rather agree with the exterior than the interior diameter of the walls of the temple; nevertheleſs the interior only is acceſſible: The exterior can be concluded only, and that by adding * the

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* It is *en deduiſant*, in the original; but this is manifeſtly an over-ſight.

thickneſs of the walls, which thickneſs cannot be meaſured but at the door, where it is not the ſame as in the reſt of the contour. 3d. Being aſſiſted by M. Moreau, at this time an architect of the city of Paris, I meaſured moſt carefully at Rome, with an iron chain, evenly ſtretched on the pavement, four radij of the Pantheon taken from the centre to the axis of four appoſite columns: I have verified at Paris thoſe meaſures, which I had marked with a file on the chain; on which verification, I made uſe of the toiſe which had ſerved in the meaſure of the degrees under the equator, aſſiſted by the Sieur Canivet, mathematical inſtrument-maker. The difference of the two radij of the diameter in the direction of north-eaſt and ſouth-weſt, is near four inches; but the whole diameter is the ſame to about an inch, as that which croſſes it at right angles, each being one hundred thirty-ſeven royal feet, and one or two inches. The celebrated Deſgodets has meaſured twelve of them with his uſual exactneſs : Some of them differ ſeven inches, which would give alone half a line difference upon the Roman foot ; the length of my diameter does not exceed the mean diameter of that architect more than four or five inches, upon adding to his three feet five inches for the radij of the two oppoſite columns, which is not included in his meaſurement. 4th. Laſtly, (and this reaſon alone is deciſive) long meaſures have never been determined but by a multiplication of the element of which they are compoſed ; that is, by the ſucceſſive application of that element to the ground. Wherefore a long meaſure cannot furniſh a greater degree of preciſion than a ſhort one. Should an architect, for example, allow 150 Roman feet to the diameter of the Pantheon, he muſt have meaſured them with his foot 150 times applied to the pavement, or ſhould he chooſe a longer rule, as a fathom or a toiſe, ſuch meaſure, or any other, can be divided no otherwiſe than by a foot, and what proof can be produced that ſuch foot is more exactly ſtandard than the ancient feet in the capitol, which differ more than a line from one another. The error ariſing from the incorrectneſs of the architects foot, would therefore be multiplied 150 times in the total length of the diameter of the Pantheon. The ſame error again may accrue from the faultineſs of a coarſe operation in the repeated *operation* of ſuch an imperfect foot; nor ſhould it be ſuppoſed that the errors committed through careleſly applying a meaſure to the ground, ſhould nearly compenſate one another; this cannot be true but when they are ſometimes more, ſometimes leſs; but a vicious manner of proceeding when it is uniform, muſt multiply the error it produces. So, for example, the application of a toiſe to the ground, by advancing it alternately on its two oppoſite faces, neceſſarily occaſions, an error of too little in each length, by the whole thickneſs of the rule.

Theſe reflexions may ſuffice to ſhew, that no greater preciſion or uniformity is to be expected among the determinations of the Roman foot, concluded from geographical meaſures of the ancient mile. One evident proof that the ancient meaſures were careleſsly made, with imperfect feet, or unequal among themſelves, is the inequality of the diſtances of the milliary ſtones yet ſtanding on ſeveral ancient roads both of France and Italy, and the various lengths of the Roman mile, which have been thence concluded. But what wonder to meet with differences of a few paces in a mile's length, after diſcovering ſeveral inches in fellow-columns of four feet diameter, and that in the fineſt ſtructures of antiquity?

As for the method employed by Villalpandus, and ſome others, for inferring the length of the Roman foot from the meaſure of the capacity of the Congius, or any other hollow meaſure, it is ſtill more ſuſceptible of error than all the foregoing, through the multiplicity of the elements which enter into the determination; whence the concluſions brought out this way, are the fartheſt of any from the mean reſult which all other values give.

After all the learned reſearches which have been gone into for three hundred years paſt, concerning the Roman foot, it ſeems as if the ſubject were exhauſted, and that nothing can be hoped for nearer than an approximation, which leaves an uncertainty of at leaſt half a line. M. d'Anville, in his treatiſe on itinerary meaſures, in 1741, after weighing every teſtimony he knew of, fixes the Roman foot at 10 inches $10\frac{6}{10}$ lines, or 130, 6 lines of the Paris foot. P. Revillas, in a learned diſſertation on the Roman foot, inſerted in the memoirs of the academy of Cortona, tom. iii. p. 122, printed at Rome in 1751, by taking a mean between the different values of the ancient foot, concluded from the ſeveral feet which now ſubſiſt, whether in marble or in metal, and from geographical meaſures, allots to it two tenths of a line more than M. d'Anville, or 130, 8 lines. M. Freret, in a poſthumous diſſertation, printed in 1756, gives the preference to the Statilian foot *,

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* *Mem. de l'Acad. des Belles Lettres*, tom. xxiv. p. 490.

which he looks upon as a mean between all the antique feet; and this foot he ſuppoſes to be 131, 2 lines. P. Boſcowich, in his meaſure of a degree of the meridian, printed at Rome in 1755, adopts M. Stuart's opinion, in his diſſertation on the ancient obeliſk lately taken out of the Campus Martius, and gives 131 lines exactly to the Roman foot, or ten inches eleven lines of our foot: This is a mean between the two foregoing values of P. Revillas and M. Freret. The Abbé Barthelemi and P. Jacquier, in 1756, ſince I left Rome, have meaſured the four carved feet, and one of metal, and found three of them equal to 130,6 lines; which length they give to the Roman foot. So far the meaſures agree to about half a line, and their mean is very little wide of the ancient foot which Luca Petto, a famous civilian of Rome, authoriſed by the government, cauſed to be graved three hundred years ago on a marble, ſtill preſerved in the capitol, whoſe meaſure may be ſet down at 130, 75 lines. But Meſſrs. Hallet and Camus having fixed the Paris ell * at 43 inches 10 $\frac{4}{5}$ or $\frac{5}{6}$ lines from the examinations they made, in 1745, of an ancient ſtandard of the Mercers of the year 1554, they found that the Roman foot (which there are good reaſons to preſume to be a fourth part of our ell) was 10 inches 11 $\frac{7}{10}$ lines or 131, 7 lines of the Paris foot. Laſtly M. de la Hire, in the memoire before cited, makes the Roman foot yet longer, and equal to 11 of our inches or 132 lines. It muſt be owned, that theſe laſt authorities are of conſiderable weight; and yet as M. de la Hire reaſons only on meaſures taken by others, and his determination being very wide of all the preceding ones, it ought not to have

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* *Mém. de l'Acad. des Sci.* 1746, p. 617.

the preference over a multitude of contrary teſtimonies. As to the valuation of Meſſrs. Camus and Hellot, it reſts upon two very controvertible ſuppoſitions; one, that the ſtandard of 1554, coarſely and unequally divided, is a faithful copy of a more ancient ſtandard preſerved without any variation ever ſince the time of Charlemagne; the other, that the ancient Roman foot underwent no alteration when that Emperor fixed the meaſures at the beginning of the ninth century. The whole duly conſidered, it ſeems, that by making the ancient Roman foot 131 lines, that is 10 inches 11 lines of our Royal foot, or perhaps a ſmall matter leſs, we ſhould come very near the truth, and keep nearly the mean between the ſmall variations which we may ſuppoſe the Roman foot to have been liable to.

I brought from Rome the actual meaſure of the Trajan and Antonine columns, that of the front of the Pantheon, and ſome others, made to as great a degree of exactneſs, as if theſe monuments had been removed to Paris. By *actual meaſure* I here mean a length equal to the thing meaſured, leaving to whomever it may pleaſe, the care of determining the number of feet and inches contained in that length. The way I proceeded was thus : I let an iron chain, charged with two or three pounds of lead, hang down from the plat-form of a capital of a column, till the lead reſted upon the pedeſtal of the column ; then I marked with a file that place of the chain which anſwered to the level of the capital ; the other dimenſions are regiſtered in like manner on my chain. Suffering it to hang at freedom, ſtretched with the ſame weight the ſame lengths will be found exactly, if the thermometer ſhew the ſame degree of heat, which was eleven degrees above freezing at Rome. Theſe meaſures may be transferred to a wall, and on it may be deſigned in an horizontal poſition, and to the height of the eye, the profile of columns, with their ſeveral dimenſions, and the curious by this means be ſatisfied, by a more comodious verification of them, than if they were upon the ſpot.

The Campagna of Rome, of old ſo populous, and adorned with ſeats of pleaſure, is at this time deſerted, and its air accounted pernicious. In an extent of country which contained five and twenty towns, you now meet with but here and there a village or hamlet. I ſpeak of the parts anciently inhabited by the Volſci, whereof Velitra, now Velletri, was the capital It is the ſame with all the environs of Rome: they are quite uninhabited, eſpecially in hot ſeaſons, except the more elevated places, as Tivoli, Fraſcati, Albano, &c.

I endeavoured to get myſelf well informed as to the generally received opinion, of the mortal danger of being expoſed to the air of the Campagna of Rome during the heats; and I am perſuaded that one runs as great a riſque in any other damp and marſhy ſoil. What is reported of the air of Rome and its environs, took its riſe from an an ancient prejudice, which though founded on reaſon originally, yet ought now to be reſtrained within juſt bounds, upon examining into the firſt cauſe of it.

This putrid ſtate of the air was firſt taken notice of after the irruption of the Goths in the fifth and ſixth centuries. The bed of the Tiber, covered over with heaps of ruins of the buildings of ancient Rome, could not but be conſiderably raiſed. Which puts this matter beyond a doubt, is that the old and well preſerved pavement of the Pantheon and its portico, is overflowed almoſt every winter; and the water riſes there ſometimes ſix or eight feet; whereas it is inconceivable that the ancient Romans would have built a temple in a ſituation ſo low as to be covered with the waters of the Tyber at every ſwell. It is therefore manifeſt, that the level of the bed of the river muſt have been raiſed ſeveral feet; which could not be without forming bars, or a ſort of moles. The choaking of its channel, muſt have neceſſarily occaſioned a reflux and over-flowing of its waters in places where no ſuch thing had been known before: Theſe waters were joined by others that had eſcaped from the ancient aqueducts, whoſe ruins are ſtill viſible, having been entirely broken and demoliſhed by Totila. What wanted there more in a hot climate to infect the ſummer air, than the exhalations of ſuch a vaſt body of ſtagnant waters, the receptacle of a thouſand kinds of filth, and the grave of thouſands of men and animals ? The miſchief could not but grow worſe and worſe from the ſame cauſes, as long as Rome was expoſed to the incurſions and devaſtations of the Lombards, Normans and Saracens, which laſted ſeveral centuries. The air was ſo very infectious at the beginning of the thirteenth century, that Innocent III. wrote, that few perſons lived to forty years of age, and that a man of ſixty was a great rarety. Soon after the Popes tranſlated their reſidence to Avignon : during their ſeventy-two years ſtay there, Rome became a deſart ; the monaſteries were converted to ſtables, and Gregory XI. on his return to Rome in 1376, could hardly count three and thirty thouſand inhabitants in it. At his death commenced the great trouble of the ſchiſm of the Weſt, and laſted above fifty years. Martin V. under whom it ended in 1429, and his next ſucceſſors, could make but feeble efforts againſt an evil then grown inveterate. And it was not before the ſixteenth century that Leo X. under whom Rome, who began to recover her ſplendor, firſt ſet about reſtoring the ſalubrity of the air; but preſently after, being twice beſieged by the Emperor Charles V. ſhe ſaw herſelf plunged again into all her calamities, and from eighty-five thouſand inhabitants under Leo X. was reduced thirty-two thouſand under Clement VII. In ſhort, it was not before Pius V. and Sixtus V. at the end of the ſixteenth century that the Popes conſtantly perſevered in purifying the air of Rome and its neighbourhood, by procuring out-lets for the waters, draining the wet and marſhy lands, and covering the banks of the Tyber, and the quarters reputed uninhabitable, with ſuperb edifices. Since that time it has been wholſome living at Rome, without any danger of coming to it or leaving it at any ſeaſon of the year: and yet at the beginning of this century it was not thought ſafe to depart from the city in ſummer after any ſtay in it, nor to return thither having once left it; nor to ſleep there, even in the day time, in any houſe but ones own *. Theſe old ſcruples are now pretty well worn away. I have ſeen cardinals, in the months of June, July, and Auguſt, going out of town to lye at Fraſcati, Tivoli, Albano, &c. and returning a day or two after, un-

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* At this preſent time a lodger in Rome cannot be compelled to quit during the ſummer ſeaſon, even for deficiency of payment.

der no apprehenſions of harm; and I have done the like myſelf, without perceiving the leaſt inconvenience: We have ſeen in the late Italian war, two armies encamped under the walls of Rome at the time of the greateſt heats. Notwithſtanding which the generality of the country people will not yet venture to go to bed, nor even to ſleep in a carriage at that ſeaſon, throughout the whole Campagna of Rome.

Doctors Lanciſi and Leprotti, phyſicians to the Popes Clement XI. and XII. and Dr. Lupi [*], have ſtrenuouſly oppoſed, both by reaſon and experience, the abuſe of this old prejudice; but the advances to truth are ever by ſlow and almoſt inſenſible degrees. Beſides, it muſt be confeſſed, that experiments made on purpoſe to prove air really wholeſome, which has been long acknowledged peſtiferous, ſavours much of novelty, and may be, perhaps, unpreſidented.

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[*] See *Joann Mariæ Lanciſi diſſertatio, de nativis deque adventiis Romani cœli qualitatibus*, Romæ 1711. *Ragionomento contra la volgare opinione*, &c. *da Giovani Girolamo Lupi*, Romæ, 1749.

I departed from Rome for Naples the ſooner, that I might get thither before the ſetting in of the great heats: However I loſt the opportunity of being a witneſs to the eruption of Veſuvius. The firſt object of my curioſity was therefore the ſubterraneous city of Herculanum, buried in the aſhes of that volcano near ſeventeen hundred years ago, and diſcovered at the beginning of this century; altho' it has not attracted the public attention till within theſe few years.

The moſt precious monuments it has hitherto produced, worthy of our attention, is doubtleſs the manuſcripts on the papyrus of Egypt, but black and almoſt calcined, nearly in the condition as if they had been taken out of an oven; they have however, found out the art of unrolling them, and poſting the leaves upon a thin ſkin, they being luckily written but on one ſide. They are now at work in tranſcribing theſe MSS. which will take up no long time; it is preſumed they will be alſo tranſlated and explained. They are all Greek, and the characters of thoſe I ſaw very diſtinct. I could read ſeveral words, and even lines without any difficulty.

What ſtruck me moſt after the MSS. was the great number and variety of family utenſils and houſhold furniture, many of them very much reſembling our modern ones; thoſe which have been hitherto preſerved, are moſtly of metal. Among other things of this kind, I ſaw ſilver cups carved, with their lids, in the manner of our coffee-pots. But theſe particulars have already afforded matter for ſeveral treatiſes, nor are antiquities my object. I ſhall therefore confine myſelf to a few reflexions on the ſtate of certain mechanic arts among the ancients, and of their progreſs among the moderns.

There have been found antique drinking-glaſſes of various ſizes and ſhapes, and alſo bottles, which proves that the ancients could both melt and blow glaſs; and even that they had a ſort white enough for windows. Had they advanced a ſtep further, they might have found the means of flattening blown glaſs as we do, and making it into pannels, and then they could not have been long in want of one of the greateſt conveniencies the moderns enjoy, almoſt without perceiving it; I mean glaſs windows and doors, which let in day-light, at the ſame time that they ſecure us from the injuries of the air; which procure us in the heart of our houſes, the diverſified ſpectacle of nature, and transform the winds, the froſts, and the tempeſts into a magnificent moving picture.

The Romans were ſtill more ignorant of running glaſs in ſheets, and making mirours of it. By a previous art the glaſs muſt have been made colourleſs as well as tranſparent, in imitation of cryſtal, and then plained and poliſhed, before they could deviſe a way of obſtructing its tranſparency, by a ſheet of tin impregnated with quickſilver. They had, not indeed, the art of tinning metals, tho' gold and ſilver they could apply very well; for the ſtatue and horſe of Marcus Aurelius in the capitol were gilt, and the kitchen utenſils found at Herculanum are often ſilvered, but never tinned. It is the contrary as to their ſolders, they being all of tin, which on account of the weakneſs of the metal, have moſtly given way.

I ſhould not forget the piece of galon or tiſſue, found in the ſubterraneous city: it is of pure gold wire, and woven like a piece of ſilk and ſtuff. They had not then fallen upon the lucky thought of ſubſtituting a ſilver wire gilt inſtead of a gold one, as beautiful altogether, leſs heavy, and at a far eaſier expence; ſo it was impoſſible they ſhould even dream of flatting ſuch gilt wire, and rolling it about ſilk thread. The Romans could not any ways foreſee, that a time would come, when a ſingle ounce of gold would be ſufficient to gild a ſilver wire a hundred leagues long.

Among great numbers of precious ſtones ſet in rings, found at Herculanum,

lanum, I could not hear of one diamond. There are very few in being which are known to be antiques; no doubt becauſe they are bought up and diſperſed as ſoon as they are found. Although from ſome paſſages of Pliny and St. Iſidorus, one would be apt to judge, that the ancients made uſe of fragments of diamonds to grave upon hard ſtones, and even to work the diamond itſelf; yet it does not appear that they had made any great progreſs in the art of perfecting the natural facettes, and to multiply and poliſh them with their own powder. I never ſaw any ancient diamonds with any other than their native points, juſt as they came out of nature's hands, except being diveſted of their ſcurf. The coloured ſtones found at Herculanum are ſet in gold, but very clumſily. I ſaw ſome rings of amethyſts, and among them, ſtones of an oblong ſhape, about fifteen lines long but very ſlender, and cut ſmooth, drop faſhion, emeralds, ſeveral graved onyxes, cornelians, &c.

If we may be fairly ſaid to have ſurpaſſed the ancients in the practice of ſome particular arts, it is not however in that of cutting and working hard ſtones. I have admired ſome of their ſmall vaſes of red cryſtal, the mouths of which are ſo narrow, that their bellies could not have been hollowed as they are, without great labour and patience; and I doubt much if any of our modern artiſts, could with all their improvements, have ſucceeded better. There is not, perhaps, an art of greater antiquity than this. I ſaw in the collection of Baron Stoch, a celebrated antiquarian at Florence, a cornelian fit for ſetting in a ring, whereon were engraven the ſeven heroes of the old Theban war, with the name of each in Greek characters.

There is not known to be any where an engraved jewel of higher antiquity, being ſuppoſed to be of the time of the Trojan war. The origin of the art is far more ancient, for it was common in Egypt before the departure of the Iſraelites, ſome of whom were lapidaries, and engravers of fine ſtones, as appears from Exodus.

The rules of decency are ſeldom tranſgreſſed in the public monuments of antiquity. The ſame cannot be ſaid of thoſe which were deſtined for particular uſes, and the furniture of houſes eſpecially. The Pagan religion laying no reſtraint on debauchery, we find that the various ornaments of their family moveables, whether painted, carved, or engraved, inſtead of the grave and ſerious, which our veneration for antiquity is apt to ſuggeſt, too frequently exhibits obſcene objects, or fooliſh whims of a capricious imagination. I once happened to be preſent when a braſs tripod juſt then diſcovered, was brought to the cabinet of antiquities at Portici, and looked upon as a greater curioſity than had been yet found; it was no leſs remarkable for the exquiſiteneſs of the workmanſhip, than for the laſcivious attitudes of three ſatyrs which ſupported the fire-pan. I had juſt then been conſidering a monument of another kind: It was a little ſilver haunch, weighing about three ounces, on which was delineated a dial; the hour lines, their numbers, and the initial letters of the twelve months being neatly engraven, and the tail of the animal of which this haunch repreſented a thigh, ſerving for the ſtyle. I had no opportunity of finding for what latitude this dial was made; which would, indeed, have been difficult, as the radius was ſo ſmall. Some judgment may perhaps be form ed of it, when all the monuments found at Herculanum are deſcribed and publiſhed, the drawings of which were in good forwardneſs in 1755.

I ſhall ſet down but a few additional experiments to thoſe of the Abbé de Nollet, on the vapour of the *Grotto del Cani*, near Naples. Emboldened by his trial, I lowered my face to the ſurface of the ground, and ſeveral times drew in with my breath, the vapour which riſes ſix or ſeven inches from the earth, like a thick ſmoak, wherein a dog loſes all ſenſation in leſs than a minute. I felt a little ſmarting in my eyes, and upon putting out my tongue, ſomething of a poignant impreſſion, without any particular taſte: I perceived ſomething in my throat, rather ſtrong than ſharp, not very unlike the effluvia of ſome weak volatile ſalt, but without the leaſt ſmell. I was not yet ſufficiently ſatisfied with my experiments, to pen them down in my journal; ſo viſited the grotto again the next day, and even a third time, the day after this, with Father de la Torre, to be well aſſured of the facts. I ſucked in the vapours three ſeveral times, my noſe touching the ground, and had the ſame ſenſations as at firſt, nothing diſtinguiſhable as to ſmell or taſte, but ſomething quick, and a little ſuffocating.

De Reaumur's ſpirit thermometer, which between ſix and ſeven in the morning, in my chamber at Naples, ſtood at eighteen degrees, being laid along on the bottom of the grotto, roſe in half an hour twelve degrees, and ſtood at thirty, about nine in the morning. This degree of heat, we know, is ſomething leſs than what is felt ſome years in the open air at Paris. In the neighbouring ſtoves of *San-Germano* the ſame inſtrument aſcended to 40 degrees, where I found my rheumatic pains were ſuſpended. Another thermometer of the ſame ſcale, but filled with quickſilver, being expoſed in the ſame place, went no higher than 39 degrees : a little further on, when this inſtrument was plunged in the great jet of the boiling ſprings at Piſciarelli, the quickſilver mounted to 69 degrees ; much under 80, which it would have exceeded, were it true, as is commonly reported, that the ſprings have the heat of boiling water.

A naturaliſt might, doubtleſs, furniſh himſelf with ſome curious obſervations, who had leiſure enough to examine the inſide of the Montenuovo, a hill about one hundred toiſes high, which aroſe out of the earth in one night in the year 1538, near Puzzoli, during one of the eruptions of Veſuvius.

June 4, 1755, I had the honour to accompany his Serene Highneſs the Margrave of Bareith to the top of the mountain, and even to the brink of the tunnel formed round the mouth of the volcano upon its laſt exploſion. This tunnel was opened in the midſt of an amaſsment of aſhes, calcined ſtones, and ſulphur, which was ſtill burning by patches, and tinged the ſoil of its own colour, exhaling thro' divers crannies. In ſome places the heat was ſo conſiderable, that though I ſtept nimbly, I could feel it pierce through the ſoles of my ſhoes. However, I made a ſhift to walk quite round it, and having thruſt a ſtick four or five feet into one of the chinks, I drew it out all of a flame.

I proceeded to the moſt acceſſible place, next the edge of the baſin, laid down on my belly, and advanced my head to view the interior of the gulph, but I could not ſee the bottom for ſmoke. For a few moments that the wind cleared it away, I looked down forty toiſes or more, and could perceive a vaſt vaulted cavity towards the north-eaſt ſide of the mountain. Into this cavity I cauſed large ſtones to be caſt, and counted twelve ſeconds by my watch, that I could hear them rolling down before they ſtopped. The Margrave and others fancied they heard a noiſe like that of a ſtone falling into a ſlough; and when nothing was thrown, they could diſtinguiſh a ſound like the diſtant roaring of agitated waves.

As we were aſcending the mountain I had the mortification to ſee my portable barometer broken in the hands of my guide, juſt as I hoped to gather the fruit of my pains in bringing it from Paris. My ſhort ſtay at Naples would not permit me to repair this loſs; nor to meaſure the height of Veſuvius geometrically, which has not hitherto been well determined * P. de la Torre procured me the neceſſary permiſſion for obſerving the height of this mountain; tho' his zeal and complaiſance were inſufficient to remove other difficulties. He has lately publiſhed a new hiſtory of Veſuvius, wherein naturaliſts may meet with ample ſatisfaction. The eruptions of this mountain have been frequent for ſeveral years paſt, and every time it throws out flames and vomits liquid matter, its external ſhape and height undergo conſiderable alterations. As I deſcended, I ſtopped at a ſmall plain on the declevity, in the form of a horſeſhoe, called Atrio di Cavallo, between the mountain of aſhes, the ſtones

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* I have been well aſſured, that the accounts publiſhed in the memoirs of the academy of Naples is not to be depended upon.

thrown out of the volcano, and a ſemi-circular incloſure of rocks two hundred feet high, which terminate this plain or valley on the north ſide: There, near the ſpiracles opened of late in the ſides of the mountain, I met with great quantities of the melted matter, which had iſſued through them in the late eruption, diſtinguiſhed by the name of *lava*, and ſpread here and there all over the valley.

This ſingular ſpectacle exhibits the appearance of metalline waves congealed; ſome idea, tho' an imperfect one, may be formed of it by conceiving a ſea of thick tenacious matter, whoſe waves begin to grow calm. Such a ſea has iſlands of ſolitary maſſes like cavernous ſpungy rocks, here and there excavated into arches and grottos, under which the liquified burning matter has ſettled, as it were in furnaces. Theſe grottos, their arches es and pillars, the pure work of nature, are charged with *ſcoriæ*, ſuſpended after the manner of *ſtalactites*, or irregular cluſters of grapes of variety of colours and ſhades. I broke off ſome remarkable fragments, and brought them to Naples, to be ſent to France, but they never came to my hands.

Whilſt I was aſcending and deſcending Veſuvius, I examined leiſurely the ſubſtance of the lava, in its various ſtates; which examination I purſued in my ſeveral viſits to Portici, ſituated at the foot of Veſuvius, where the King of the Two Sicilies has a pleaſure ſeat, built upon the ſoil which covers the ruins of Herculaneum.

By the term *lava*, is not to be underſtood all the ſeveral ſubſtances thrown out of the mouth of the volcano,

cano, as aſhes, pumice-ſtones, ſand and gravel; but thoſe only which the intenſity of fire, having reduced to a liquid ſtate, are formed into ſolid maſſes by cooling, and of a hardneſs ſurpaſſing that of marble. Notwithſtanding ſuch reſtriction, it may be apprehended that there are ſeveral ſorts of lava, according to the different degrees of fuſion of the mixture, or its participation of more or leſs metal, or being more or leſs intimately united with different ſubſtances. I diſtinguiſh it into three principal ſorts, with ſeveral intermediate ones. The pureſt lava, when poliſhed, reſembles an opaque ſtone of a dirty grey colour; it is ſmooth, hard, ponderous, interſperſed with ſmall fragments like black marble, and ſeems to contain metalline particles. At the firſt view it looks like the ſerpentine, excepting that the lava is without any caſt of green: It receives a pretty a pretty fine poliſh, more or leſs lively in different parts: Tables, chimney ornaments, and even ſnuff-boxes are made of it. At the court of Naples I have ſeen tables of lava an inch thick, ſome of which were veined and warped, as if they were of wood. The coarſeſt ſort of lava is uneven and rough, not unlike the clinkers of forges or ſcum of iron. The commoneſt ſort of all is of a middle texture, between theſe two; it lies in large maſſes on the ſides of Veſuvius, and in the neighbouring fields, having run down thither in torrents, and in cooling formed itſelf into heaps like rocks of ruſty iron, many feet thick. Theſe maſſes are frequently interrupted, and ſometimes covered over by heaps of aſhes and calcined ſubſtances, projected from the bowels of the mountain, and falling down like rain. The ſalts which they contain, mixing with the dry leaves of trees, vines and plants, which grow upon the mountain, and with the dung brought thither, do in proceſs of time, and often between one eruption and the next, compoſe a new layer of earth, which proves exceeding fertile, till in its turn it is covered with lava. Under many alternate beds of lava, aſhes and earth, amounting in the whole to an incruſtation from ſixty to eighty feet thick, have been diſcovered temples, porticos, ſtatues, a theatre, and an entire city,

I could never diſcover any ſubſtance like lava in America, though we often encamped weeks and months together on volcanos, particularly on Pitchincha, Coto-paxi, and Chimboraço, on which I ſaw only the remains of calcination, without liquefaction: And yet that kind of darkiſh cryſtal, in Peru commonly called Pedra de Gallinaço, ſeveral pieces of which I brought home, (one of them being a poliſhed lens of ſeven or eight inches diameter (depoſited in the cabinet of the king's garden) is nothing but glaſs formed by the volcanos. The matter of the fiery torrent which is continually running down from that of Singay, in the province of Macas to the ſouth-eaſt of Quito, is unqueſtionably a lava; but we ſaw that mountain only at a diſtance, and I had left Quito at the time of the laſt eruptions of Cato-paxi, when a ſort of ſpiracles were opened in its ſides *, from whence flowed out waves of flaming liquid matter, which muſt have been of a ſimilar nature to the lava of Veſuvius.

It is well known that Naples is paved with this ſubſtance, but it is amazing that the ſame has not been

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* See *Journ. Hiſt. du voyage à l'equateur, au Louvre*, 1751, *p.* 156, &c.

remarked of the paving of Rome, I mean of moſt of the ancient highways, and perhaps of all thoſe whereof there are any remains, from Rome to Naples: and on the road from Naples to Pouzzoli and Cumæ. The Appennine way, which ſtill ſubſiſts, and is a part of the highway from Rome to Naples, is paved entirely with lava.

This may ſeem the leſs ſtrange, when it is known that the foundations of the houſes of the ſubterraneous city of Herculaneum, built two thouſand years ago, are of pure lava; which may ſuffice to decide a queſtion controverted in the academy of Belles Lettres, and manifeſtly proves that the great eruptions of Veſuvius are not all poſterior to that which ſwallowed up Herculaneum. Notwithſtanding that city is really buried under ſeveral beds of lava, properly ſo called, it ſhould not however be ſuppoſed that its ſtreets, areas, and houſes are choaked up with it, in ſuch a caſe the pix-ax and chiſel would be uſeleſs. The ſubſtance which fills the inſide of the city, was never melted nor liquid; but is an immenſe amaſſment of aſhes, earth, gravel, ſand, coal, pomice-ſtones, and other ſubſtances, launched up from the mouth of the volcano at a time of its exploſion, and fallen down all round it. Theſe at firſt buried all the buildings, and afterwards by degrees got into the inſide of them, by their own weight and the drift of winds and rain, and laſtly by the falling in of the roofs and floors. This mixture clung together by the infiltration of waters, became condenſed by time, forming a kind of ſand-ſtone more or leſs hard, but eaſily penetrable. Such is alſo the ſoil of the high ground which over-looks Naples on the north and weſt-ſides;

as likewiſe of Capo di Monte, the Chartreux, the Caſtle of St. Elne, and particularly of the ſteep hill on the ſea ſhore as you go from the city weſtward. Such alſo is the ſoil of the riſing ground through which runs the famous antique ſubterraneous paſſage, above a mile long, known by the name of the Pauſilypan grotto.

All the mountains and hills about Naples, will be found upon examination, to be huge heaps of matter vomited out by volcanos which are now extinct, whoſe eruptions, anterior to hiſtory, ſeem to have formed the ports of Naples and Pouzzoli. It is not in Naples alone, and its neighbourhood, that I have met with ſuch like ſubſtances. As my eyes have been accuſtomed to diſtinguiſh the different emanations of Veſuvius, and eſpecially the lava under its variety of aſpects, I could trace it with eaſe and certainty, the whole way from Naples to Rome, even to the very gates, ſometimes pure, and again combined with other ſubſtances.

The whole inſide of the mountain of Fraſcati, where was Cicero's Tuſculum, the chain of hills which extends from Fraſcati to Grotta-Ferrata, Caſtel-Gandolfo, and even to the Lake of Albano, a good part of the mountain of Tivoli, thoſe of Capravola, Viterbo, &c. conſiſt of beds of calcined ſtones, pure aſhes, cinders, gravel, a ſubſtance like iron droſs, terra-cotta, and lava, properly ſo called; in a word, ſo like in all reſpects to the compoſition of the ſoil of Portici, and to the materials which have iſſued out of the ſides of Veſuvius, under ſuch a diverſity of forms. The ſight alone is ſufficient to diſtinguiſh all theſe ſeveral ſubſtances. The aſhes are manifeſt, both from the colour and the taſte. It is impoſſible for any one that has attentively examined the productions of Veſuvius, not to be ſatisfied of a perfect reſemblance between them and thoſe he will meet with at every ſtep in his way from Naples to Rome, from Rome to Viterbo, from Rome to Lorretto, &c. It then neceſſarily follows, that all this part of Italy has been ruined by volcanos. Thoſe plains, now ſo ſmiling and fertile in olive-trees, mulberry-trees, and vines, like the hills at preſent about Veſuvius, have like them, been over-ſpread with burning inundations, and bear, as they do, not only within, but on their ſurface, infallible marks of fiery torrents, whoſe waves are now fixed and conſolidated, bearing teſtimony of vaſt ignitions, prior to all monuments of hiſtory.

I do not take upon me to renew the ſyſtem of Lazaro-Moro, a Venetian author, whoſe work I met with in my journey to Naples, (printed at Venice in 1740.) This writer will have it, that all mountains wherein marine bodies are found, and of conſequence the continents, which are the baſes of ſuch mountains, have been all thrown up by the force of ſubterraneous fire, from the bottom of the ſea. Hiſtory furniſhes him with proofs of a conſiderable number, and the reſt he inferrs by induction. His aſſertion, which I ſhall not deny, is too general to admit of a ſatisfactory proof; my own I reſtrain to obvious facts, from whence I deduce no other than neceſſary conſequences. When on an elevated plain I ſee a circular baſin invironed with calcined rocks, the verdure of the neighbouring lands cannot impoſe upon me. I know that I am viewing the remains of an old volcano, as ſurely as I could diſcern the marks of an extinguiſhed fire by a heap of coals and aſhes. If there be a breach in ſuch incloſure, I generally diſcover the track of a ſtream or the bed of a torrent, by carefully ſearching the declivity; and the rock itſelf, when cloſely examined, often proves to be perfect lava. If there be no breach in the incloſure, the rain-water and ſprings there collected, without any aperture to run off by, muſt needs form a lake in the very mouth of the volcano.

The bare repreſentation of the Lake of Albano, on a topographical map, with its ſteep borders and its incloſure of pointed rocks, brought to my remembrance the Lake Quilota, which I have elſewhere deſcribed, whoſe waters ſometimes exhale flames. Some days after, the actual view of the Lake of Albano, and the calcined bodies interſperſed here and there in its borders, left me no room to doubt about its origin. I plainly ſaw the deep tunnel of an ancient volcano, in whoſe mouth the waters were accumulated. Its erruption, which hiſtory takes no notice of, muſt have been before the foundation of Rome, and of Alba, from whence the lake has its name, that is near three thouſand years ago.

Upon viewing the marks of fire ſcattered round the lakes of Borſello, de Rociglione and Bracciano, on the road from Rome to Florence, I formed the ſame conjectures, before I had ſeen either Veſuvius, or the ſubſtances it vomits forth : I paſs the ſame judgment, by anology, upon the lake of Perugia, and ſeveral others of the inland of Italy, which I know no otherwiſe than by the map.

Upon the whole, I look upon the Appennine as a chain of volcanos, ſimilar to that of the Cordeliere of Peru and Chili, which runs from north to ſouth, the whole length of ſouth America, the province of Quito, and Terra Magellanica. The continuation of the volcanos of the Cordeliere is interrupted; great numbers of them are extinct or quiet, but a great many remain, which are actually burning: Old ones frequently revive, and ſometimes new ones are kindled up, even in the ſea, whoſe effects are no leſs dreadful. Lima and Quito, the two principal cities of Peru were the victims of either ſort within a few years. The chain of thoſe of the Appennine, which traverſes the continent of Italy, likewiſe north and ſouth, and extends as far as Sicily, exhibits at this day a great number of viſible and different ignitions. In Tuſcany, the exhalations of Firenzuola, the thermal waters of Piſa; in the Eccleſiaſtical State, thoſe of Viterbo, Norcia, Nocera, &c. in the kingdom of Naples, thoſe of Iſchia, the Solfatara and Veſuvius; in Sicily and the neighbouring iſles, Ætna or mount Gibel, the volcanos of Lipari, Stromboli, &c. But other volcanos of the ſame chain, extinct or exhauſted time immemorial, have left relicks behind them, which, though perhaps, not ſtriking at the firſt view, cannot eſcape the notice of attentive eyes. Moreover the earthquakes which at different periods have overthrown ſeveral cities of Sicily and Italy; that which ſwallowed up the city of St. Euphemia in 1638, of which Kircher draws ſo pathetic a picture; that which deſtroyed Catanea in 1693; that which opened the gulphs of Palermo in 1718; that which, ſince this account was written, ſhattered Syracuſe; bring to mind the diſaſter of Valparaiſo, Calao, Lima and Quito in ſouth America, and cloſe the parallel between the Cordiliere of Italy and that of Peru. The features of reſemblance are but too ſtriking.

I do not affirm that all mountains are in the caſe of the Appennines. I could not obſerve the ſame appearances in that part of the Alps which I travelled over; but I have found the like in Dauphiny, Provence, and ſeveral places where they were never looked upon as the effects of fire *. It is not therefore in Italy alone that the veſtiges of calcination and vitrification

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* In 1760, three years after I had finiſhed this account, I brought from Balarue, a village of Languedoc, on the ſea coaſt, famous for its hot ſprings, pieces of a porous ſtone, calcined like pumice-ſtone, but hard, blackiſh and ponderous, in every reſpect like the coarſeſt ſort of lava; or rather to thoſe ſtones which floated in lava whilſt it was in a liquid ſtate, which being impregnated with lava, are frequently miſtaken for it.

cation are to be met with, in places where volcanos have never been ſuppoſed to have exiſted. France affords inſtances, and poſſibly moſt countries. My conjectures about the ancient volcanos of Italy, of which I find marks in all parts, and on the lava, which likewiſe I diſcovered even in places where I the leaſt expected it, appeared to me ſo evident, that my only wonder was, they ſhould be new; they were however, looked upon as whims, in a country, where I ſtill think, nothing more than the plain uſe of ones eyes is neceſſary to produce the like. I underſtand that they are like to meet with a better reception in France. It will be no longer hard to comprehend, that great part of Italy is covered with the ruins of old unknown volcanos, and therein lava, properly ſo called, and not different from that of Veſuvius; now that Mr. Guellard has publiſhed his memoire, and ſhewn the exact reſemblance between that ſubſtance and thoſe found in Auvergne, by the compariſon he has made of the fragments of the lava of Veſuvius and Mount Gibel, ſent him from Italy, with the ſeveral lavas which he found himſelf on the mountain of Volwich, Puy de Domne, and Mont d'Or.

I have been informed that at Clermont in the ſame province, they employ a porous ſtone in their building, which notwithſtanding is very hard, and I ſuppoſe of the ſame nature as the Tivoli ſtone, (Lapis Tiburtinus) uſed in many of the ancient edifices of Rome, as the Tullianum priſon, built under Tullus Hoſtilius. This ſtone carries marks of the action of fire, being very coarſe, and intermixed with various heterogene ſubſtances. In another ſort of ſtone very common at Rome, called Peperino, flakes of white marble are incorporated, very like what is frequently found on Veſuvius, in the clefts of the rocks which encloſe the little horſe-ſhoe plain I have ſpoken of. On the ſame ſtone, which may be conſidered as an impure lava, may alſo be diſtinguiſhed fragments, which look like black marble. In the laſt eruption of Veſuvius, pumice-ſtones, and others half calcined, were obſerved to float on the ſurface of the burning liquid lava. It muſt conſequently happen, that ſtones immerſed and retained by any obſtacle within the melted maſs, will be frequently penetrated on all ſides, by the various liquid matters of which the lava is compounded. I have a ſample of coal which I got out of the cavities of a ſtone of the caſtle of Citta-Caſtillana, a days journey from Rome. To what other cauſe can the interior diſpoſition of certain rocks be naturally aſcribed, ſuch as thoſe remarkable ones ſeveral parts of the coaſts of Genoa, particularly to the north of Cape delle Melle? They are a mixture of ſeveral variouſly coloured ſubſtances, not diſpoſed in ſtrata, but in waves, reſembling in ſome ſort, thoſe of marbled paper, as if thoſe ſubſtances had been ſuddenly fixed under a ſtate of boiling. What muſt we ſay of that particular ſand or duſt in the neighbourhood of Pouzzoli, commonly called Pouzzolane, and of which ſamples may be met with in other places, though not ſo well known, if it be not a mixture of calcined ſtones, ſcoriæ and ruſt of iron reduced to a powder? I am no leſs inclined to believe, that the thick metalline ſand, ſo common in America, on which Muſſchenbroeck has made many experiments*, is a production of volcanos.

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* *Diſſertatio de Magnete. M. Muſſchenbroeck* informs us, that the ſand he performed his operations upon came from Virginia. I met with it every where in Peru: In the province of Quito it is very common.

Be it as it may with theſe laſt conjectures, they have nothing in common with the fact which I aſſert concerning the pavement of Rome and the Appennine way, &c. &c. I again inſiſt, that to be convinced that it is the very ſame ſubſtance as the lava of Veſuvius, a man needs nothing elſe but the uſe of his eyes: thoſe who require authorities, I refer to Mr. Wagner, a learned naturaliſt, phyſician to her ſerene highneſs the Margravine of Bareith, whom I found to be of the ſame opinion as myſelf, when I mentioned to him my thoughts concerning the Roman roads round about Naples and Rome. He added, that at about three days journey from this capital, as he was coming from Florence, from the mountain Radicofani, he had obſerved the ſame different calcined ſubſtances as thoſe I had taken notice of, though not before I came near to Aquapendente, and which at that time I did not know to reſemble the lava of Veſuvius. Another no leſs deciſive ſuffrage in ſuch a matter, is that of M. Soufflot, comptroller of the king's buildings, from whom I have been informed, ſince I laid this memoire before the academy, that in his laſt journey to Italy in 1752, he viſited Capo-di-Bove, a mile from Rome, from whoſe quarry they fetch the ſtones which pave the city, and that he was well ſatisfied this pretended ſtone, was in nothing different from the lava with which the ſtreets of Naples are paved. It may be had at a place ſtill nearer Rome than Capo-di-Bove; for I have ſeen pure lava going cloſe by the gate of St. Sebaſtian, in the way from Fraſcati to Rome. It is ſtrange that a matter of fact ſo eaſy to be proved, ſhould ſtill retain the air of a paradox.

The prince of San-Severo, gentleman of the bed-chamber to his Sicilian majeſty, and knight of the order of St. Januarius, celebrated for ſcientific acquiſitions, and his taſte for chemiſtry, and the arts, ſhewed me at Naples ſome eſſays upon a very ſhort vegetable ſilk, which at that time they had juſt found out the way of ſpinning; it is of a tree of the growth of the country, whoſe leaves differ little from thoſe of the willow. The botaniſts call it *Apocynum*. This ſilk looks very like that which they get from a large tree in America, called *Fromager* among the French iſles, and *Seyba* by the Portugueze of Para. In the French colonies they make no manner of uſe of it; but I have ſeen it uſed for a ſort of down beds in Para. Prince San-Severo gave me ſome ſamples of this ſilk ſpun, and worked up into a ſtuff; it is of a flame colour, looks like a coarſe thick mohair, and takes no gloſs till it has paſſed the calender.

There has been for ſome years paſt an academy of ſciences at Naples, one of their volumes has been printed. It owes its birth to the zeal of a few private perſons; but it is ill kept up for want of regulations and patronage: in 1755 there was a talk of forming one of hiſtory, under the authority of the government, to deſcribe and explain the antiquities of Herculaneum; ſince which there have appeared two volumes in folio of explanations of thoſe monuments, publiſhed by the ſociety.

It is common to take a trip to Naples at the time of the feaſt of St. Januarius, biſhop of Naples. They have a phial of cryſtal richly mounted, which according to antient tradition, contains ſome of the blood of the holy martyr, which after having been well ſhaken for ſome time, uſually turns liquid to the view of the ſpectators. I ſay uſually, becauſe it does not always do ſo, and then all the people of Naples are thrown into the greateſt conſternation. I was ſorry that I had left Naples without being preſent at this ſolemnity, but good luck made ſome ſort of amends. One evening that I waited on the Margravine of Bareith, a phial was brought to her, ſet in a circle of braſs or ſilver gilt, ornamented on the top with a caduceus, to diſtinguiſh it from the phial preſerved in the cathedral church. This whole apparatus was put into the hands of the princes, and then the Margrave and others laid hold of it, and at length myſelf. The phial ſeemed to be half full of a greyiſh maſs or paſte, and the inſide ſurface looked duſty; after turning it ſeveral ways, and ſhaking it, in about half a mia minute, the paſte grew liquid and ran; ſometimes in part, at others all of it: then it would fix again, and again liquify when ſhaken a-new. All this it would do, nor did the intention, deſire or expectation of the perſon that held the phial, ſeem to contribute in the leaſt to the effect. I ſaw the experiment ſeveral times repeated, not only that evening I have mentioned, but ſince in open day light, at the man's houſe who owned the machine, where I had opportunity of examining it at leiſure. At the bottom of the phial, I took notice of two ſmall cones, of what ſubſtance I know not, oppoſed to one another at their vertex, which the man ſaid were perforated with a ſmall aperture. He added too, that they were hollow, and that the under cone was moveable, in ſuch ſort, that its orifice ſometimes met that of the upper, and ſometimes did not, juſt as it happened, upon the motion given the phial, making the axis to meet or not to meet. As for the duſt which I diſcerned in the phial, I was told it was an amalgama of quick-ſilver, lead, tin, and biſmuth: that the biſmuth, which amalgamates but imperfectly, hindered the mixture from becoming an abſolute compact paſte, and gave it the form of a powder too coarſe to paſs the ſmall aperture which communicated with the two cones; laſtly he added, that a circular pipe concealed within the ornament, which opened into the lower cone, contained fluid quickſilver; that by ſhaking the phial irregularly when the aperture of the two cones happened to meet, the quickſilver inſinuated itſelf in a greater or leſs quantity, and liquified the amalgama; that it ſometimes happened through the variety of motions impreſſed on the machine, that the introduced quickſilver made its exit again through the ſame hole, and that then the amalgama remained no longer fluid. I relate with all poſſible exactneſs what the poſſeſſor of this ingenious machine at that time told me, and I penned it down the ſame day: All I can affirm is, that it performed its feats very prettily. He promiſed me an exact deſcription of it, with a drawing of its ſeveral parts, to preſent to the academy; and he ſince repeated the like promiſe in writing, but he has not hitherto performed it.

On my return from Naples to Rome, Cardinal Valenti, miniſter and ſecretary of ſtate to his Holineſs, did me the honour of a preſent of ſix copies a new tranſlation, made by his order, of my treatiſe on the inoculation of the ſmall-pox, read the year before at the academy. In the converſation I had with his eminence on this ſubject, he gave me to underſtand,

ſtand, that wrong grounded theological ſcruples, would have but a ſmall chance at Rome, in oppoſition to a practice ſo manifeſtly tending to the benefit of mankind. The divines with whom the cardinal miniſter had conferred on this ſubject, had informthemſelves as to the true ſtate of the queſtion, ſo as not to be miſled by falſe repreſentations, and accordingly they judged it very conformable to the principles of chriſtian charity, to obviate a mortal danger to which every one in the courſe of life is expoſed from the day of his birth.

At the ſame time I underſtood, that the ſame maternal tenderneſs which elſewhere retarded the progreſs of inoculation, had contributed to it in the eccleſiaſtical ſtate; where it was not uncommon for mothers, inſtead of waiting for the ſurgeons operation, to inoculate their children in their ſleep, and unknown to their fathers, by a ſingle puncture: And never was any thing attended with happier ſucceſs, as may be ſeen in the literary journal for July 1755, publiſhed at Rome: The ſame year this practice was introduced into Tuſcany by authority of the government, in the hoſpital of Sienna, and in the autumn of 1756, in that of Florence. It is now in vogue at Piſa. Doctor Targioni has juſt now printed an account of its ſucceſs. It gains ground every where daily. From Geneva it has made its progreſs thro' Swiſſerland and Germany, where the moſt eminent phyſicians have declared in its favour *. Holland, Denmark and Sweden, are in poſſeſſion of it. I forbear mentioning England,

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* Baron Vanſweiten wrote me in January 1757, that he propoſed to inoculate ſeveral the enſuing ſpring. See M. Hallers's letter to Dr. Tiſſet, in juſtification of this practice. I have alſo read a MS. of M. Wherloff to M. de la Virotte, on the ſame ſubject.

where it has not met with a ſingle opponent among all their phyſicians and ſurgeons: Thus are we inveſted on all ſides with inoculation. The Spaniards are the only neighbours we have, among whom it has not as yet gained admittance. We are obliged to them, for that we have not been the laſt nation in Europe to adopt ſo ſalutary a meaſure: In the mean time, notwithſtanding our whole nation has not as yet enjoyed the fruits of it, we can name ſome illuſtrious inſtances, one of which may be taken as a more ſufficient proof in favour of the method, than a multitude of others, guided only by a principle of ſervile imitation *. Our divines would be aſhamed to aſk ſeriouſly, if it be in conſequence allowable to make uſe of a precaution, the effect of which, as

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* The Duke de Chartres and his ſiſter Mademoſelle de Montpenſier, were both inoculated in 1755.

every day's experience evinces, is to ſecure thouſands yearly from becoming the victims of the ſmall-pox? Our magiſtrates and biſhops do not know that inoculation was once arrained at their tribunal by an anonymous perſon; but they are fully ſatisfied that M. Chais *, had beforehand victoriouſly ſilenced all the objections, moral and theological, of blind and inflamed zeal; and that father Berti, one of the moſt learned Florentine divines, as well as ſeveral other catholic doctors of Italy, have publickly taken up the defence of the artificial ſmall-pox. There can then no longer ſubſiſt any reaſon or pretence for alarming the conſciences of ſuch, who regardleſs of all evidence, will be ruled by nothing but authority.

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* Eſſai apologetique de l'Inoculation, par M. Chais, printed for de Hondt at the Hague, 1754.

As to ſuch phyſicians, as in their writings may have openly oppoſed inoculation, were their characters, their numbers, and the inſiduouſneſs of their language capable of miſleading the judgment, yet would I ſtill ſtrenuouſly inſiſt, that the proper buſineſs of a phyſician in regard to inoculation, is only to examine, whether the preſent ſtate of the perſon who would be inoculated, is ſuch as to render it improbable that any benefit would accrue to him from the operation. As to this point, 'tis doubtleſs highly expedient, that a phyſician, and one of known experience too, ſhould be conſulted. But, for what concerns the general queſtion, whether inoculation be a ſalutary practice? or even this other, whether it is adviſeable to inoculate children? the thing ſhould be decided by the calculation of probabilities. The problem thus limited, is ſubject to the like operations as that of lotteries, being purely an arithmetical one, and no more wanted towards the ſolution, than to take a ſurvey of the liſts of thoſe who have been inoculated in the ſmall-pox, and foundling-hoſpitals at London. As to a juſt eſtimate of the hazard of inoculation for adults of different ages, the problem becomes more complicated, not yielding to analyſis, but by approximation, from a want of accuracy in the mortality, eſpecially in France *; It is notwithſtanding no leſs evident, that inoculation would ſave the ſtate

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* The mortality bills in France contain only the number of the dead, without any diſtinction of ages or diſeaſes. The London bills are far more perfect, and exhibit in one column how many have died at ſuch and ſuch ages; and in another, what number have died of each particular diſorder: But theſe two are not conjoined; nor does it appear in what proportion the mortality, owing to one particular diſeaſe, as the ſmall-pox, is diſtributed among different ages.

a multitude of ſubjects, which periſh by the ſmall-pox in the natural way; nor leſs true, though not ſo manifeſt, that on account of its being advantageous to the ſtate, it follows, that prudence dictates the uſe of it to particulars, except in extraordinary caſes. Inoculation will never have any enemies to encounter, but ſuch as cannot make themſelves maſters of this truth, though ſo well proved, or others, who though ſufficiently convinced thereof, oppoſe it with reaſons which they do not chooſe to publiſh.

Having pretty well recovered my health during my long reſidence at Rome, I wrote to Paris for a pendulum with a metal rod *, which would

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* *Pendule* often ſignifies a pendulum clock: This however was no clock, but a ſimple pendulum, abſolutely detached from wheel-work. The author, in his *Journal du Voyage à l'Equateur*, pag. 144, ſays the rod was of ſteel, twenty-eight inches long, ſuſpended by edged pivots, in the manner of Mr. Graham's ſimple pendulum, carrying at bottom a ball of nine pounds. *J. B.*

continue vibrating twenty-four hours; the ſame I made experiments with at Quito, Para, Cayenne, and Paris. Father Boſcowich, a jeſuit, and a famous geometrician, one of thoſe who meaſured two degrees of the meridian from Rome to Rimini, ſupplied me with every conveniency for repeating my experiments with this pendulum in the Roman college, where he had a meridian line already drawn. They were made accordingly, and continued under his inſpection, as well as my own, nine days together, by repititions. The reſult of all was, that in October 1755, my pendulum made 98865½ vibrations in 24 hours of mean time. M. de Reaumur's thermometer ſhewing 17 degrees above the point of freezing. This number, compared with that of its vibrations at Paris, Quito, Cayenne and Para, will give the difference of the length of the pendulum, which ſwings ſeconds in all theſe places, to the greateſt exactneſs, upon reducing them all to the ſame degree of the thermometer. I went alſo ſeveral times to the college of the Engliſh jeſuits, to viſit the obſervatory of father Mair (father Boſcowich's aſſociate in the meaſure of the degrees) and obſerve immerſions of the ſatillites, or occultations of ſtars by the moon: But clouds defeated our purpoſes. None but aſtronomers know how many obſervations they are deprived of by ſome accident or other, for one they can make to their ſatisfaction. I reſerve, for another occaſion my experiments, with the thermometer, barometer, compaſs, and dipping needle, made at Rome and other places during my travels.

Charles VIII. on his return from his expedition to Naples in 1495, founded a college of French Minims to the Trinity of the Mount, in one of the fineſt ſituations in Rome. The clock belonging to this convent is of the utmoſt emolument to ſtrangers, being the only one in the whole city that can inform them what hour it is.

As the eccleſiaſtical day begins at midnight throughout the chriſtian world, and all the rights of the Roman church are accordingly regulated, it is ſomewhat unaccountable, that at Rome, the civil and the eccleſiaſtical day ſhould not begin together, and that Italy alone, ſhould ſo particularly differ from the received cuſtom of every other part of Europe. The Italians begin counting the hour from the end of the day; an equivocal, arbitrary term, and morally impoſſible to be fixed. This way of diſtinguiſhing time ſavours much of barbariſm, and puts one in mind of the old ſtupid rule for fixing the limits of day and night, by making the day to end when objects could no longer be diſtinguiſhed. But what objects? How far off? At what ſeaſon of the year? And in what weather? Problems which admit of as various ſolutions, as there are diverſities of objects, diſtances, eyes, ſeaſons, and viciſſitudes of the atmoſphere.

Hence it comes to paſs, that at Rome, and almoſt all over Italy, they count every day at noon a whole hour different from what they did the day before; and that noon, tho' the knowledge of it be neceſſary in eccleſiaſtical matters, varies above three hours from winter to ſummer. When it is noon at the ſolſtice of June, the clocks at Rome ſtrike only ſixteen; but at that of December, nineteen. As the length of days, eſpecially when eſtimated from the evening twilight to that of the next morning, differs ſeveral minutes from day to day, to ſave the trouble of altering their clocks every day, they have cunningly contrived to wait till the differences from day to day have amounted to about fifteen minutes: and conformable to this regulation, all the clocks in the city ſkip a quarter of an hour on a ſtated day, ſometimes after a week, ſometimes a fortnight, and ſometimes ſix week. A printed almanack ſets forth, that from the 16th of February, for example, to the 24th, it will be noon at a quarter paſt 18; but that on the 24th it will be noon exactly at 18, and that for as long as till the 6th of March, &c. that from the 1ſt of June to the 13th of July, it will be 16 o'clock at the moment of noon; but on the ſame 13th of July it will begin to be noon at 16¼, and ſo of the reſt, in ſuch manner that noon will advance on in the courſe of the year from 15 to 18 o'clock, not by an inſenſible progreſſion from day to day, but by ſkips of a quarter of an hour each, between certain days and their next ſucceeding ones, after an even march of eight, fifteen, and ſometimes forty days. I was ſtudying a long while what advantage might attend ſo whimſical a cuſtom, and the only one I could conceive, was that it is no eaſy matter at Rome to know that your watch goes wrong.

It is manifeſt that this uſage is not only grounded on the groſſeſt ignorance of the elements of aſtronomy, but is likewiſe very perplexing in the practice. Neverthelеſs, ſuch is the tyranny of cuſtom, that in the native country of Galileo, Kirker, Riccioli and Caſſini, few are ſenſible of the inconveniency of it. The moſt eſteemed mathematicians of Rome, father le Seurand Jacquier, French minimes,

nimes, well known for their learned comment on the *Principia* of Sir Iſaac Newton. The fathers Maire and Boſcowich have been conſulted, to know if it would be worth while to reform this abuſe. It is eaſy to judge of the nature of their anſwer. However the nuiſance ſtill ſubſiſts, and is likely to do ſo a good while longer.

The Emperor, in his Tuſcan dominions, and the Duke of Parma in his, have within theſe few years cut this gordian knot, by iſſuing orders for counting the hours as is done in the other parts of Europe. It was not without difficulty that thoſe princes got themſelves obeyed, and there are ſtill murmurings on that account. A thing which added to the repugnancy of the wide ſpreading vulgar, was imprudently naming ſuch time-keepers as begin ſhewing the hour from midnight,

night, ***French clocks***, an appellation by no means proper to recommend them. Beſides, they fancy it ſo natural and ſimple to reckon the hours from the end of the ſenſible day, ſo whimſical and and puzzling to divide the night and the day into halves, and to diſpoſe the hours according to the terms of midnight and noon, of which there is nothing to inform the ſenſes; that without the interpoſition of authority, the old way would never have been altered. The aſtronomical method met with the greateſt oppoſition in getting admittance into the nunneries. According to the old way of counting from ſun-ſet, the hours of all religious exerciſes in the cloiſters were every day different, or rather had different names, tho' in effect they were the ſame. Matins, I will ſuppoſe, began always ſix hours after midnight, but at 10 o'clock at one ſeaſon of the year, and at 13 o'clock at another. Dinner time at 15 o'clock in ſummer, and 19 in winter, took ſucceſſively the name of all the intermediate hours, and every thing was well. Now, becauſe reckoning from midnight, the religious lodges enter the choir the whole year round at 6 in the morning, and the refectory bell rings every day at noon, every thing appears to them in diſorder and confuſion.

Rome, as well as the greater part of the cities of Italy, has ſeveral literary ſocieties, under the title of academies: ſometimes they hold public aſſemblies, at which divers pieces of poetry are read, particularly ſonnets, a favourite kind in Italy for above three centuries paſt. The 17th of Auguſt 1755, I aſſiſted at the aſſembly of academicians named *Quirini*, held in a grove of the *Corſini* gardens, ſome of the moſt elegant in Rome.

A portico of verdure with open arches, ſupported by trees cut into columns with their baſes and capitals, formed a vaſt ring about an octogonal baſon. This rural periſtile was decorated with ſteps, and the circumference of the baſon with ſeats for a numerous audience; lower ſtill was erected an amphitheatre far more richly ornamented, being a kind of throne for the academicians. In front, directly before the baſon were placed eighteen ſuperb benches in a ſemicircle, for cardinals and ambaſſadors. So unexpected a ſight ſtruck me wonderfully: I fancied myſelf at Elis in the golden days of Greece, and that I beheld the judges diſtributing crowns to the victors in the Olympic games.

The Roman academy of ſculpture and painting, has been lately enriched by ſeveral new preſents, through the liberality of the ſovereign pontiff, and juſt now, by the foundation of a drawing-ſchool, with a hired model, as at the academy in France, began by Lewis XIV. and ſtill kept up in its full luſtre.

But it is ſomewhat amazing that in all this capital there ſhould be no ſuch thing as a ſociety for cultivating natural philoſophy and mathematics: Rome has not any academy of ſciences. It was but a few years ſince that any particular aſſemblies of antiquarians were formed in a city where the moſt beautiful monuments of the magnificence of the ancient Romans are continally attracting our notice. To this day there are neither revenues nor penſions annexed to this eſtabliſhment, ſufficient to ſupport it, by rendering the members of it a little independent; and it may be ſtill affirmed, as well of ſcientific as hiſtorical knowledge, that it remains abſolutely unconcentrated at Rome.

The ſcholars and antiquarians are here diſperſed; and, as I may ſay, inſulated: Some there are of the latter ſort, who have acquired great reputation by their works. The names of Bottari, Pacciandi, Boyardi, Bianchini, Vettori, Venuti, and ſome others, are well known; but a great number of young fellows of narrow circumſtances, prompted by a juſt taſte and talents for ſtudying the monuments of antiquity, are obliged to devote part of their time to a ſlight inſtruction of travellers, in order to raiſe a little money, and ſo are leſs at leiſure to purſue their labours to any great purpoſe. Thus they become jealous of one another without any motive of noble emulation; being leſs ſollicitous about acquiring new knowledge, than of ſupplanting their competitors; whereby they are moſt of them fixed down to a ſtate of mediocrity.

Can it be imagined that throughout all Italy, where, in many ſmall towns they have ſome literary academy, whoſe concerns are eloquence and poetry, there ſhould be but one for antiquities, and only one for ſciences? and that both theſe owe their origin to two particular perſons, zealous for the glory of their country: the former eſtabliſhed a few years ſince at Cortona, on the frontiers of Tuſcany and the Eccleſiaſtical State, by the aſſiduity and care of the late Marquis Venuti, brother of the before-mentioned Abbé Venuti, and now ſupported only by the zeal of its members, notwithſtanding it has already publiſhed ſix volumes of diſſertations: the other more ancient, and better known by the name of the Inſtitute of Bologna, the work of the famous Count Marſigli, who was both its founder and benefactor. He purchaſed a palace for the reception of its members, and bequeathed the noble collection of natural hiſtory and antiquities made by Ulyſſes Aldrovandus, which he bought and greatly enlarged. The reigning Pope *, a native of Bologna, whereof he was archbiſhop, at the time the tiara was conferred on him as the reward of his virtues, honours with a particular protection, an eſtabliſhment which diſtinguiſhes this city above all others of Italy. There are four-and-twenty penſioners, called Benedetti, after the name of their founder.

Among the favours his Holineſs was pleaſed to beſtow upon me, the recommendatory letter made out, of his own proper motion, in virtue whereof the academy of Bologna did me the honour of admiſſion into their illuſtrious body, without waiting for ſuch a vacancy as their regulations

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* Benedict XIV.

preſcribe, is not to be eſteemed one of the leaſt.

No church in the whole chriſtian world ſtands leſs in need of foreign decorations, than that of St. Peter at Rome, eſpecially as no leſs than twenty Popes, ſince the time of Sixtus V. have generouſly devoted their treaſures to the embelliſhment of that edifice. And yet an old cuſtom is ſtill kept up, and ſtrangers obſerve with regret and amazement, that on all great ſolemnities the pilaſters of the baſilica of St. Peter, are covered with rich hangings, whoſe materials and glaring colours break the harmony of the majeſtic architecture, and interrupt the view of the marble lining, and the ornaments of ſculpture which decorate the whole inſide of the temple. Be it as it will, this cuſtom of ſo frequently puting up and taking down hangings, together with the difficulty of getting up to the ceilings, or even to the lower ſide arches, often ſets the Italian artiſts upon exerciſing their mechanical talents. The engraved collection of ingenious and commodious machines invented, ſome of them for the church of St. Peter, by Zabaglia, a man of genius, though a plain carpenter by profeſſion, is well known. In April 1756, I ſaw one of Signor Giovanni Corſini Roni, whoſe conſtruction was equally ſimple and elegant. It was made to be uſed in repairing the inſide of the dome of the Pantheon. It ſupplied to advantage an expenſive apparatus of ſcaffolding, ſuch as we were ſo fond of in France upon the like occaſions. It was no other than a plain pair of ſtairs, about eight feet wide, hung to the top of the dome, and reſting below upon a quadrant of a circle concentric to the inſide of the dome: the curvature was preſerved by a framing of carpentry, like that of the centers of arches, with only this difference, that here, for the ſake of lightneſs, the planks were ſtrait and ſet edge-wiſe, inſtead of ſquare beams. Through the ſummit of the arch went a ſtrong iron pin, ſerving as a pivot or axe, by which pin it hung down from the middle of a ſtrong beam, reſting diametrically on the round opening thro' which the church receives its light. The bottom of the ſteps had rollers faſtened to them, which bore on the circular cornice of the dome. This whole machine, which was near 70 feet high, might be turned about ſo eaſily that it yielded to the ſlighteſt impulſe, and as it moved about ſix feet at once, the workmen could ſhift themſelves with as much conveniency as ſafety, to any height and ſide of the dome. I have been informed that a model of this machine may be ſeen at Paris, in the poſſeſſion of M. Trouart, a young architect, who brought it with him from Rome.

There is now at Rome a faſhionable diverſion, which retains nothing of the ſavage barbarity of the combats between the gladiators of old. Some of the Roman princes and nobility delight in training up horſes for the race; not as in England, with a rider on their back, but by themſelves at full liberty, ſpirited by their own natural ardour, and an emulation which the concourſe of ſpectators ſeems to inſpire. Eight or ten horſes, commonly barbs, and little mean looking creatures, kept all on a line by a cord ſtretched breaſt high, ſtart the inſtant the cord is dropped. In the carnival races, the moſt ſolemn of any, the courſe is uſually in a long ſtreet of Rome, from thence called *Il Corſo*, or *Race-Street*, which on this occaſion is gravelled over: It is about 865 toiſes in length *. I obſerved twice with a ſtop watch, by means of a ſignal, that this diſtance was run in 141 ſeconds, being about 37 feet in a ſecond. This ſwiftneſs will be found conſiderably greater upon due reflexion, than it at firſt ſeems to be.

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* From the ſaid ſtretched cord (which is 74 feet beyond the obeliſk of the Porta del Popola) to the ſaliant angle of the palace of Venice.

It appears manifeſt, that we cannot allow more than two ſtrokes or galloping progreſſions to a ſecond, ſince each ſtroke requires at leaſt three really diſtinct inſtants of time; that at which the horſe ſprings from the ground, that in which he is ſeen bounding through the air, and that when he touches ground again. So that two ſtrokes to a ſecond, imply ſix ſeparate inſtants, ſcarce diſtinctly perceptible in ſo ſhort a time. Theſe horſes being ſmall ſized ones, and running over 37 feet in a ſecond, muſt advance above 18 feet each ſtroke, and nearly equal to four times the length of their bodies, taken from the breaſt to the crupper. It is true that this length is more than doubled, by the extenſion given to their fore and hind legs in their gallop. All things conſidered, how can the ſwiftneſs of the Engliſh horſes be much greater, as in fact it is? But there are certain caſes where truth exceeds the limits of probability, and this one of them.

The late M. du Fay in 1737, wrote from Newmarket, that the Engliſh four miles courſe *, where he was a ſpectator, was run in eight minutes wanting three or four ſeconds. Thoſe miles are 826 French toiſes, which gives more than 41 feet and $\frac{2}{3}$ each ſecond, or near 5 feet more than the barbs of Rome; it is

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* The Engliſh mile was fixed by Henry VII. at 1760 yards of 3 feet each; and conſequently contains 5280 Engliſh feet, equal to 4957 Paris feet, or 826 Paris toiſes; the proportion of the Engliſh to the French foot being as 1352 to 1440.

very remarkable too, that thoſe run at full freedom, whereas the Engliſh racers are charged with the weight of the rider. Moreover this velocity of of 41 feet and $\frac{2}{3}$ in a ſecond, is a pretty common degree of ſwiftneſs, for out of ten which ſtarted together, the horſe which came in laſt, was not above 12 or 15 paces ſhort of the firſt. And yet more, it is aſſerted that the ſame courſe has been ſeveral times run over in ſix minutes and ſix ſeconds. This I have from a perſon who has often betted at Mewmarket *. Now this velocity, which amounts to above 54 feet in a ſecond, is to that of the barbes, almoſt as 3 to 2. It ſhould be further obſerved, that inſtead of an Engliſh mile, or a ſmall matter more, which is the meaſure of the Roman courſe, that of Newmarket is four miles, a ſpace too long for any horſe to keep to an equal ſpeed all the

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* Mr. Taaffe.

way; and it is certain he muſt ſlacken towards the end: conſequently the *maximum* of the velocity muſt be above 54 feet in a ſecond, and that nearer the beginning of the courſe. It is accordingly ſaid, that a famous running horſe called Sterling, ſometimes ran the firſt mile in one minute which is at the rate of 82 feet and $\frac{1}{2}$ in a ſecond; an inconceivable ſwiftneſs! even ſuppoſing it exaggerated, as 'tis like it was; concerning which I expect further ſatisfaction *. Such a veloa velocity, had it continued ſome ſeconds, it might have been fairly pronounced that the horſe went ſwifter than the wind, it being extremely ſeldom that the moſt violent wind makes ſo much way. The greateſt known velocity of a ſhip at ſea is ſix marine leagues in an hour, and ſuppoſing the ſhip to take a third of the velocity of the wind which impels it, the velocity of ſuch wind would not amount to 80 feet in a ſecond.

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* I have received the following ſince this memoire was read, from Doctor Maty, a Librarian at the Britiſh Muſeum, and author of the *Journal Britannique*, in good eſteem. There are, ſays the Doctor, two courſes at Newmarket, the long and the round; the former is exactly four Engliſh meaſured miles, and 380 yards, (or 7420 yards, equal to 3482 French toiſes) The ſecond is not four Engliſh miles, wanting 420 yards of it. (that is only 6640 yards, or 3116 toiſes.) *Childers*, the ſwifteſt horſe in any ones memory, ran the firſt courſe in ſeven minutes and a half, and the ſecond in ſix minutes and forty ſeconds, (which amounts to 46 feet and 5 or 6 inches French in a ſecond) whereas all horſes ſince, are at leaſt 7 minutes and 50 ſeconds in perform- ing

I left Rome April 2d, 1756, and took the road to Loretto. On my way, I ſaw the famous caſcade of Terni. Miſſon, a pretty exact tra-

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ing the former, and 7 minutes the latter, (that is 44 feet and 5 or 6 inches to a ſecond.) Theſe, adds Doctor Maty, I look upon as certain: He adds, that it is commonly ſuppoſed that theſe racers, cover at every ſtroke a ſpace of about 24 Engliſh feet. This differs but little from my own conjecture of about two ſtrokes in a ſecond. Each ſtroke would be about 18½ French feet for the ſwifteſt barbs at Rome, and 22 or 23 feet for the Engliſh racers; ſo that the ſwiftneſs of theſe ſhould be to that of the barbs, nearly as 4 to 3.

veller, makes it 340 feet high. I cannot believe that it was ever yet exactly meaſured, the local circumſtances ſeem to render it very difficult. Upon comparing its total height, with a part of it which I meaſured myſelf. I am apt to think that it exceeds not 200 feet. ·This caſcade looks to be three times as high as that of Tivoli. There is one in the Iſle of Sora, not ſo well known, as lying out of the high road, which I went to ſee as I returned from Naples; it is not ſo high, but broader than either of the former. The Garigliano, formed by the junction of the Lyris and the Fibreno, a mile below the junction, ſeparates into two arms, upon meeting with a rocky iſland, and falls by two caſcades; one perpendicular, 60 feet deep, and forty feet wide; the other far leſs rapid, but no leſs ſingular, nor leſs agreeable to the view.

April 27, at Loretto I ſaw the ſun riſe beyond the Adriatic ſea 4 degrees and $\frac{1}{2}$ to the eaſt of the north by compaſs; whence I concluded the declination of the needle 15 degrees and 35 minutes from the north weſtward. I hoped at ſun-riſe to have ſeen the mountains of Dalmatia on the other ſide the gulph of Venice, but clouds prevented me this and the following days, along the coaſt, which I kept from Ancona to Ravenna. However by diligent enquiry, I met with ſeveral perſons in thoſe parts, who aſſured me from ocular teſtimony, of another fact, which tho' I had heard of before, was of no uſe to me; that there are ſeveral points of the Apennine on the frontier of the Eccleſiaſtical State, Tuſcany, and the Dutchy of Modena, from whence may be ſeen the two ſeas which border Italy on the right and left. It was no vain curioſity that induced me to be thoroughly certified of the truth of this, on account of the great uſe that might ariſe from ſuch a concourſe of rare, and perhaps ſingular circumſtances.

Within theſe laſt twenty years there have been five different menſurations of the earth in Latitude [‡], and hardly one in Longitude [§]. The ſeeming impoſſibility of ſucceeding to a ſufficient exactneſs, for want of being able to find an arch of a parallel to the equater which is large enough [*] to meaſure, has rendered this method in a manner deſperate. But if there be a place in all the world, the moſt favourably circumſtanced in all reſpects for meaſuring a large arch in longitude, it ſeems to be this part of Italy.

[‡] In Lappland, in Peru, in France, at the Cape of Good Hope and in Italy, performed in 1737, 1742, 1752, 1755.

[§] By Meſſrs. Caſſini de Thury and de la Caille, on the coaſts of Provence and Languedoc, in 1742. See *La Meridienne de France verifié*, p. 105.

[*] The probability of the error in the meaſure, as to the moment of ſeeing an inſtantaneous ſignal, being the ſame on a great arch as on a ſmall one, will be ſo much the leſs upon each degree, as the arch contains a greater number of them.

A ſignal placed on one of the ſummits of the Apennine, where the Adriatic ſea may be ſeen to the Eaſt, and that of Tuſcany to the Weſt, cannot fail of being viſible from either coaſt, provided it be of a ſufficient magnitude. I ſuppoſe that it may be ſeen from Ravenna or Rimini on one ſide, and from Leghorn or Piſa on the other. Here then is an arch of more than two degrees in longitude to be meaſured eaſily: But this is not all, and this diſtance may at leaſt be doubled; I prove it thus: From the intermediate ſummit of the Appennine, whence the two ſeas are ſeen, one to the Eaſt the other to the Weſt, the view can be terminated but by objects which cloſe the horizon of the ſea, and can be ſeen from both coaſts. From this ſummit,

mit, therefore, in clear weather, will neceſſarily be ſeen the ſun riſing from behind the mountains of Iſtria and Croatia, and ſetting behind thoſe of Genoa ; and conſequently a ſudden flame of ſufficient ſize, produced, either by a heap of powder, as I propoſed in 1735 ‡, and which was put in practice in 1740, or by a paſteboard bomb placed on the choſen ſummit of the Appennine, may in a ſerene night by two obſervers, planted each with a regulated clock, the one at Monaco, or on ſome mountain of Genoa, the other on Cape Pola near Trieſte in Iſtria. The difference of the hour when each obſerves the artificial phœnomenon, will give the difference of the meridians of the two obſervatories, and the meaſure of an arch of near five degrees in longitude.

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‡ See *Mem. de l'Acad. des Sciences* for 1735, p. 1. and *Merid. de Paris verifié* p. 98.

Although this difference could certainly be determined nearer than to about a ſecond *, and I think it poſſible

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* I have often found, by experiment, under the equator, where the ſtars riſe perpendicularly and very quick, that it is not difficult, by taking correſpondent altitudes, to be certain of the inſtant of noon, and eſpecially of the culminating of a ſtar to about half a ſecond, and ſkilful obſervers may poſſibly attain a greater degree of precision. This half ſecond of time anſwers to an arch of ſeven ſeconds and a half of a degree, which at the Equater may be eſtimated at 120 toiſes, but will be reduced to 84 toiſes at the parallel of 44½ degrees. But, 84 toiſes of error on an arch of five degrees, would produce but 17 toiſes on a degree, whereas I have ſuppoſed 34; the reaſon is this. The difficulty of determining the time exactly by correſpondent altitudes, increaſes in an oblique ſphere, where the apparent motion of the ſtars is ſlower, and increaſes exactly in the ſame proportion as the obliquity of the ſphere, or the inverſe ratio of the coſines of the latitudes. Thus, for inſtance; under the parallel of 60 degrees, whoſe radius is the ſub duple of that of the Equator, the arch, ſuppoſe of 7 ſeconds and ½, would be ſhorter by one half, and conſequently would be only 60 toiſes inſtead of 120; but the difficulty of getting the time exactly, would alſo be twice as great under this parallel, and inſtead of half a ſecond of error, which we ſuppoſe poſſible under the Equator, there would under the parallel of 60 degrees be danger of erring a whole ſecond of time, which is 15 ſeconds of a degree.

ſible to attain to a greater degree of preciſion, provided every requiſite precaution be taken, and eſpecially if the

degree. But an arc of 15 ſeconds of a degree, but half ſo great, is equal in length to an arc of 7 degrees and ½ of a degree twice as great as it. Wherefore there will be an exact compenſation, and the error the obſerver is liable to in determining the time, will be the ſame under whatever parallel the operation is performed; which has not been as yet remarked that I know of, at leaſt not explained. It follows from hence, that the accuracy of the aſtronomical menſuration of an arc of longitude may be equal in all countries, and that it depends ſolely on the length of the arc in toiſes, whatever be the number of degrees. If therefore I keep to the ſuppoſition of half a ſecond, by which I eſtimate upon my own experience, the error that may be committed in the determination of the time, by correſpondent altitudes under the Equator, this error would not produce proportionally but 42 thirds under the parallel of 44 degrees and ½, and would not produce, like that of half a ſecond under the Equator, more than 120 toiſes of error on an arc of 5 degrees; that is, but 24 toiſes on a degree, inſtead of 34, as I have computed. But as the ſcheme which I propoſe, requires two obſervers, and as it may happen, abſolutely ſpeaking, that their errors, inſtead of amounting to nothing, or to leſs than I have ſuppoſed, ſhall be as great as poſſible, and that inſtead of compenſating, they be doubled: Notwithſtanding that obſervations repeated and multiplied is a morally certain the obſervations be multiplied; this error of a ſecond of time, equal to 15 ſeconds of a degree, anſwers on the parallel of 44 degrees, but to 170 toiſes, which diſtributed through 5 degrees, comes to leſs than 34 toiſes of error for a degree; conſequently the meaſure of ſuch arch of about 5 degrees of longitude, would afford as much or more exactneſs, as our meaſure of three degrees of the meridian, as to which I think I have proved, that we could anſwer to about 40 toiſes *.

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certain remedy for ſuch accidents, I have ſuppoſed the total error of the two obſervers, one whole ſecond, even from taking a mean among all the obſervations. This ſecond anſwers not to full 170 toiſes on the parallel of 44 degrees and $\frac{1}{2}$; and it is on ſuppoſition of ſuch an error, which exceeds the limits of probability, that the error on a degree would be ſcarce 34 toiſes. It is therefore manifeſt, that the propoſed menſuration in longitude, is as ſuſceptible of as great, if not greater preciſion, than of our menſuration of the three degrees on the meridian.

‡ See *Maſeure des trois premiers degrés du meridian*, p. 232.

If Father Ximenes, the reſtorer of the Florentine meridian, is commiſſioned to make a map of Tuſcany, and to meaſure an arc of the meridian, his geodeſic meaſurements, when joined with thoſe of the fathers Maire and Boſcowich, will extend from one ſea of Italy to the other, and put him in great forwardneſs to execute the meaſure in longitude which I have propoſed, and which would be ſo proper for furniſhing new lights concerning the figure of our globe.

Upon my arrival at Bologna, I was to acquit myſelf of the obligations due to the gentlemen of the inſtitute. Count Caſali, one of the profeſſors, and Signor Zanotti, perpetual ſecretary of that illuſtrious body, did me the favour to accompany me every where. At Bologna may be ſeen in one palace, what in London and Paris is diſperſed in all quarters of the city, a publick library, enriched daily with new preſents from the Pope; an obſervatory; cabinets of natural hiſtory, experimental phyſics, mechanics, medals and antiquities; ample collections and preparations, natural and artificial, in anatomy; academy rooms, for painting, ſculpture, and civil and military architecture, adorned with plates in relief, and models of military machines; cloſets of geography and navigation; in a word, whatever can ſuit a taſte for arts and ſciences, and facilitate human knowledge. I was preſent at ſeveral lectures and academical diſcourſes. One of the profeſſors of anatomy is Signora Laura-Baſſi, verſed in Greek and Latin literature, the wife of Signor Verati, another celebrated profeſſor. She is not the only Italian lady, in our days, who has acquired reputation in the republic of letters, by her genius and knowledge. The treatiſe of fluxions by Signora Agneſi of Milan, is well known, although the author has lately gone and buried her talents in a cloiſter; alſo the learned tranſlations of Signora Ardinghalli of Naples, who in her very tender years was admired for the progreſs ſhe had made in natural philoſophy.

Beſides the luſtre which ſo fine a foundation as the Inſtitute caſts upon Bologna, that city is one of the largeſt and moſt beautiful in all Italy. Every thing contributed to make my reſidence there agreeable. Nor indeed ſhould I have wanted any more for this end than the houſe of Field-Marſhal Palavicini, late governor of Milan, who has choſen Bologna for his reſidence, and from whom, without any letter of recommendation, I met with the frankeſt and moſt agreeable invitations. Bologna ſet the leading example, which moſt of the other cities in Italy have followed within theſe twenty years, in eſtabliſhing a Caſino; ſo they call a magnificent and elegant houſe, furniſhed and kept in repair by the nobility of a city at their common expence. The beſt company of both ſexes repair thither every evening, and ſtrangers of condition, after having been once preſented, are alſo admitted. Bologna is governed as a republic, by the authority, and under the regulations of a Senate. The Popes, to whom it yielded a voluntary ſubmiſſion for ſeveral centuries ago, have there an enjoyment of honours and ſovereignty; the Bologneſe, notwithſtanding, have maintained their privileges. They have an ambaſſador in ordinary at Rome, and know how to connect the benefits of a republican ſtate with thoſe of a monarchical one.

I have ſpoken of the meridian of Bologna before, and of the hanging tower, which attracts the attention of ſtrangers.

After a curſory view of Reggio, Modena, and Parma, and conceiting myſelf in France when I came to Colorno, where I had the honour of paying my court to the Infant Duke of Parma and the Infanta. I paſſed on to Mantua and Ferrara, whence I went to Venice about the end of May, to be preſent at the ceremony of the Doge's annually eſpouſing the Adriatic ſea, a feſtival and tumultuous ſeaſon, and quite unſuitable to ſuch obſervations as require eaſe and tranquility.

Among various curioſities which they ſhew to ſtrangers, in the little arſenal of Venice, is a piece of cut velvet on a gold ground, as remarkable for its fabric as its antiquity. It is a preſent of Uſſum-Caſſan, King of Perſia, to the Republic of Venice, to whom he ſent ambaſſadors in 1572. The gold ground looks as if it had paſſed through a flatting mill, and yet the pile of the velvet is raiſed. It repreſents neither branches nor lively coloured flowers, like ours, but human figures, tolerably well deſigned. and the fleſh and draperies are ſhaded in imitation of nature. This effort of art, which it would perhaps be found difficult to excell even at this time, may ſerve to ſhew how long ago that of working ſilk had been brought to perfection in the eaſt. Such a preſent of ſo powerful a monarch to the Republic of Venice, plainly implies, that the fabric of this ſort of velvet was unknown in that capital, and is a good proof of the ſuperior excellence of the eaſtern nations in ſuch works, at leaſt that they were long before-hand with the Europeans therein, whoſe ſilken manufactures had, notwithſtanding at that time, ruined thoſe of Greece.

The art of weaving ſilk was brought into Europe under the Roman Emperors. But having been exiled into the remoteſt parts of Aſia after the invaſion of the Barbarians, it was brought back to Conſtantinople in the ſixteenth century, by the monks who returned from Serinde, between the Indus and the Ganges. The manufactures of ſilk ſtuffs eſtabliſhed in Greece, and tranſlated to Sicily by Roger, about the year 1148, were brought to perfection at Luca, Bologna, and Venice in the following century, three hundred years before the firſt pair of ſilk ſtockings preſented to Henry II. appeared in France. It was known that the leaf of the mulberry tree was the proper food for ſilk worms; but it was wrongly conceited that thoſe trees could not thrive but in a hot climate, which prejudice alone, retarded their tranſplantation from Sicily and Calabria,

bria, into the north of Italy, ſeveral centuries. Since that time, they have been found to grow very well in France, and even in much more northern countries: an example which ſhould induce us to proper trials for naturalizing in our own climate other uſeful productions which nature has refuſed us.

From Venice I took the rout of Turin, and ſtopped only a few days at Padua and Milan, one of the cities of Italy with which ſtrangers are moſt delighted, and to which the French are the leaſt ſtrangers: The manner of living there, is very like that at Paris, in compariſon of any other place in Italy.

The famous Ambroſian library poſſeſſes, among other riches, nine or ten thouſand ancient manuſcripts, many of them oriental, brought from

Syria, Greece and Egypt: they are all bound, but without titles, and diſtinguiſhed only by numbers. We know thoſe which have been noticed by the Fathers Mabillon and Montfaucon. The celebrated Muratori, in his vaſt collection of Italian hiſtorians, has publiſhed ſome of them; the reſt are unknown. They are kept ſecret, even a ſight of the catalogue is denied to ſtrangers; whence it might be ſuſpected that it is imperect. If the intention of the founder* had been purſued, by employing for a century and a half ſixteen men of learning, well verſed in various kinds of literature, and the languages, to decypher, explain and publiſh theſe manuſcripts, the republic of letters would have long ago gathered the fruit of their labours: but for want

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[*] Cardinal Frederic Borromeo, archbiſhop of Milan, couſin of St. Charles, and his ſucceſſors.

of ſufficient funds, three doctors only are retained in this library at preſent, ſo that moſt part of the treaſure continues buried.

In the cabinet of pictures annexed to the Ambroſian library, I ſaw a numerous collection of deſigns of machines, of the hand and invention of Leonardo da Vinci, contemporary and rival of Michael-Angelo. It is well known, that Leonardo was invited into France by Francis I. and expired in the arms of that prince when he received a viſit from him. Beſides his merit as a painter, he was a very good mathematician for that time of day.

His maſter-piece is a picture in freſco, repreſenting our Lord's laſt ſupper, with the twelve Apoſtles, ſomething larger than nature; it is 20 feet long by 10 deep, and is to be ſeen in the refectory of the Dominicans at Milan. It is ſurpriſing to find a picture now ſo very freſh, which appeared to Miſſon ſo black and ill preſerved fourſcore years ago, that he affirms, he could diſtinguiſh nothing in it. The preſent colouring does not indeed reſemble that of the other works of Leonardo. It will not ſuffice to imagine, that about five and twenty or thirty years ſince, this picture was cleaned by ſome unknown ſecret, as they give out to travellers; it muſt have been new painted entirely: and in this I have been in a good meaſure confirmed. It is therefore highly probable, that the beautiful ordonance, the choice of the attitudes, the diſtribution of the figures; in a word, the compoſition, is all that now remains of the original author in this piece. I ſhall deviate from the object I propoſed in this memoir, by remarking, that not only the rules of perſpective, too often neglected by the great maſters, are regularly obſerved in this picture, but likewiſe thoſe of optics. A judgment may be formed of what I advance, by the different poſition of the luminous point, variouſly reflected by the cryſtal vaſes, according to the ſeveral forms and poſitions, more or leſs oblique, with regard to the incident ray of light.

I ſaw ſome experiments at Turin, which to me were new, on the effects of gun-powder; and two machines which I thought very ingenious: one was a wind-gun, which was charged by firing through a touch-hole two ounces of powder incloſed in a thick braſs cylinder: the train by commucating the fire thro' a very narrow channel, burns a thread, which by a deſcent cloſes the valve of the chamber wherein the powder is confined, which inflames inwardly without exploding. The air dilated by this inflammation retains its ſpring many months: a ſmall portion of which is made to paſs into a ſecond chamber by opening a valve, which immediately ſhuts it in, and this ſmall quantity, upon pulling a trigger, is ſufficient to carry a lead bullet ſixty paces; it will make ſucceſſively eighteen diſcharges, but continually weaker and weaker.

The other machine is for meaſuring the ſtrength of powder, which here alſo is fixed within a cloſe braſs cylinder: the dilatation of the air produced by the inflammation, cauſes ſome water, contained in the bottom of the ſaid cylinder, to aſcend in a glaſs tube fitted to it. Then the air is let in again, and a forcing pump applied to the cylinder, wherein is ſhewn how much the air requires to be condenſed in the cylinder, to raiſe the water within the graduated glaſs tube, to the ſame degree the inflammation of the powder had raiſed it to. The author of both theſe machines is M. Mathi, penſioner of the king of Sardinia.

In Signor Donati's cabinet of natural hiſtory at Turin, I ſaw ſeveral trunks of trees petrified, brought from the mountains of Genoa. There is no room for queſtioning the reality of their petrification.

I paſſed over Mount Cenis the 4th of July 1756; the ſnow was not then all thawed, and the 14th of the preceding June, the waters of a ſmall lake abounding with trout, ſituated on the top of a narrow road, through which the high road paſſes, were ſtill frozen over.

Mount Cenis being reputed one of the higheſt in Europe, I was deſirous of trying the experiment of the barometer there, and comparing the height of the quick-ſilver, with thoſe I had obſerved on the high mountains of Peru. I got upon the moſt elevated point, in the neighbourhood of the great road to the right hand, 15 or 16 hundred toiſes from the aforeſaid lake, and the hoſpital of pilgrims. I had already aſcended from the village of Novaleſe for three hours, on horſeback, on a newly repaired road. I climbed up four hours more on foot, the laſt hour on a dry ground ſtrewed over with flakes of rocks, or a ſort of thick coarſe intermixed ſlate, and here and there ſnow in the hollows. I ſtill wanted about twenty toiſes, perpendicular height, of the top of the mountain, when croſſing a ravin filled up with ſnow, whoſe ſlant was pretty ſteep, I found my feet ſlip. All I could do was to throw myſelf on my backſide, in which poſture I ſlid down 12 or 15 toiſes, with my hands and feet thruſt againſt the ſnow to retard the rapidity of my deſcent. (I dwell the more on thoſe particulars, as they may be of ſervice on a like occaſion) I ſtopped where the bed of ſnow ended, and the rocky fragments appeared again, and came off with a bruiſe in my foot, and a few ſcratches. I recovered, not without fatigue, the foot of the rock, where my guide, a country fellow, had waited, not much diſcouraged by my accident, becauſe I found my barometer whole. I found the height of the quickſilver to be 19 inches 10 lines and $\frac{1}{2}$ *, that is to ſay, one line and three quarters lower

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* This experiment was well made with the portable barometer, broken at Mount Veſuvius, which I got put to rights at Rome. Since my return to Paris, I have compared it with ſome of the beſt con-

lower than at Quito in the Spaniſh America, near the equator, where upon a great number of experiments, we fixed the mean height of the quickſilver at 20 inches and ¼ of a a line *, the height which anſwers to that of 1460 toiſes above the level of the ſea; whence I concluded, that the place where I made this my new experiment, was not elevated above twenty toiſes more than Quito, whoſe level exceeds by above twenty toiſes, the top of the Canigou, the higheſt of all the Pyrenean mountains †. It is true, that from my ſta-

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conſtructed and the beſt graduated barometers, according to which, I have corrected the heights which I obſerved.

* See in the *Journal Hiſt. du Voyage à l'Equateur*, p. 163. the Latin inſcription left at Quito.

† The Canigou is 1440 toiſes high, according to the geometrical menſuration of M. Caſſini. The Quickſilver in 1740 ſtood there at 20 inches 2 lines and ¼. See *Obſerv. de l'Hiſt. Nat. de M. le Monnier, le medecin, Meridienne verifiée*, p. ccxxiv.

tion, I ſaw ſome other points of Mount Cenis higher than thoſe where I performed my operations, but the difference was not conſiderable, not 50 toiſes, according to the beſt of my judgment.

Returning to the hoſpital of Pilgrims, I there obſerved the height of the quickſilver in the ſame barometer, at 3 o'clock in the afternoon, to be 22 inches and ½ a line, that is, 26 lines more than at my ſtation on the top of the mountain, which gives near 500 toiſes for the difference of the height of my two ſtations.

Mount Cenis is not by a great deal the higheſt mountain of the Alps. Monte Blanco *, which may be ſeen from the borders of the lake of Geneva at 14 or 15 leagues diſtance,

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* It has ſeveral names.

towards the ſouth-eaſt, the upper part of which is perpetually covered with ſnow, is incomparable more elevated. M. Fatio de Duillier meaſured its height geometrically, and gives it at leaſt 2000 toiſes above the ſurface of the Lake, which laſt he makes 426 toiſes above the level of the ſea, by a calculation founded on the fall of the Rhone after its diſcharge out of the Lake of Geneva, eſtimating that fall at no more than double that of the Loire, meaſured by M. Picard. Thus the total height of Monte Blanco is 2426 toiſes above the ſea, according to M. Fatio, which would be very nearly the height of the ſtony and eaſtern ſummit of the volcano of Pitchincha, where I ſaw the quickſilver in the barometer deſcend to 16 inches *. But M. de Chezeaux,

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* The city of Quito, ſince in great part overthrown by an earthquake, is ſituated at the foot of the

Chezeaux, who meaſured a much greater baſe than M. Fatio, and conſequently muſt have more accurately determined the heights, enlarges the height of Monte Blanco ſtill more, and that by 250 toiſes. Suppoſing therefore the height of Lake Leman, or of Geneva, above the level of the ſea, well eſtimated by M. Fatio at 426 toiſes, the abſolute height of Monte Blanco would be 2676 toiſes, which exceeds the height of the Pic of Teneriffe by 500 toiſes, though this paſſes for the higheſt mountain in Europe*. Accordingly Monte Blanco may

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the volcano of Pitchincha, the higheſt ſummit of which is about 1000 toiſes higher than the level of that city.

* Father Feuillée, in his manuſcript voyage to the Canaries, gives the height of the quickſilver at the top of the Pic of Teneriffe, 17 inches and 1 line; which compared with the heights of the quickſilver, but little different, which we obſerved on the mountains of the Cordeliere of Peru, whoſe height

may be ſeen near Langres, at the diſtance of 60 leagues, whence its ſummit may be diſcerned covered with ſnow, over the chain of Mount Jura. This prodigious height, which exceeds that of the Canigou by more than 1200 toiſes, does not however come near that of the higheſt mountains of the Cordeliere of the Andes in

height was geometrically meaſured, gives that of the Pic of Teneriffe 2150 toiſes, to more exactneſs than reſults from the geometrical meaſurement of the ſaid Father Feuillée, who concludes it 2213 toiſes from a baſe too ſhort and ill directed, and the inclination of which he did not conſider. For the reſt, the heights of mountains concluded from the barometer, are ordinarily liable to conſiderable error, if there has been no correſpondent obſervation made at the ſame time at the level of the ſea, and in the neareſt place. This circumſtance is not neceſſary in the neighbourhood of the Equinoctial, where the variations of the barometer are exceeding ſmall, the greateſt ſcarcely exceeding one line at Quito. So that near the Equator, the height of mountains may be frequently determined by the barometer alone, within about 10 or 12 toiſes. See *Meaſure des trois premiers Degrés du Meridien*, p. 56.

Peru; for out of thirteen whoſe height I computed, ſeven are higher than Monte Blanco, and as Chimboraco particularly ſurpaſſes it by 550 toiſes, its height above the ſea, geometrically meaſured being 3220 toiſes, it is beyond all contradiction the higheſt moutain that is known, and probably the higheſt in the world: Its inacceſſible part, only from the foot of the perpetual ſnow where I was encamped, to the ſummit, is 800 toiſes perpendicular *.

The melting of the ſnow in ſummer, which is ſtopped every night in

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* By very exact experiments of the height of the barometer, made at the ſame time at Geneva and Turin, on the ſea ſhore, communicated to me by M. J. A. de Luc, citizen of Geneva, whilſt this memoire was printing, it appears that the height of the Lake of Geneva, taken at the ſurface of the Rhone, at its paſſing out of the Lake, is but 1124 feet, or leſs than 188 toiſes above the level of the ſea, inſtead of 426; which leſſens the height of Monte Blanco 238 toiſes.

the

2676
238
2438

the narrows of the Alps, and renewed the next day during the time the ſun ſhines hotteſt, occaſions ſome odd phœnomena. A valley as far as the eye can diſcern, covered with uneven flakes of ice, reſembling waves, the ſurface of this ſea congealed, interſected with deep channels, the noiſe of a ſubterraneous torrent, which heaves up this enormous maſs, and daily changes the aſpect and level of it: theſe alternate, and in a manner ſudden effects, variouſly connected with heat and cold, form the grandeſt ſpectacle of its kind that can perhaps be any where ſeen; highly worthy of the curioſity of the naturaliſts, and likely to furniſh new obſervations. Scheuchzer, in his *Iter Alpinum*, gives the deſcription of the Glacieres or Glaciers of Swiſſerland, a name given to theſe vaſt emaſſments of ice; but the Glaciers of Savoy appear to be very different. The moſt celebrated, and alſo the moſt curious among them, is about three days journey from Geneva, towards the ſources of the Arve at the foot of Monte Blanco. The way to it, is through the valley of Chamougny. I was upon the point of leaving Geneva, when I was informed of theſe matters: this journey requires eight days at leaſt, beſides preparations and conveniencies, of which I was wholy unprovided; nor ſhould it be attempted by any ſingle perſon. Some Engliſh gentlemen performed it in 1741, but without any inſtruments. M. Jallabert lent me a ſhort relation of their enterprize, printed without any name of an author, and fitter to excite curioſity than to ſatisfy it.

This is not a proper place for me to teſtify my acknowledgments of the favourable reception I met with from all the miniſters of France, at the ſeveral courts of Italy where I made any ſtay, and of the marks of benevolence, with which I was honoured at Rome by ſeveral cardinals. But my obligations to the Count de Stainville *, our ambaſſador then at the court of Rome, the leaſt of whoſe favours was entertaining me almoſt a year in his houſe, call upon me no longer to defer my public teſtimony of them.

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* Now Duke de Choiſeul.

Meaſures of ſeveral ancient Monuments at Rome exactly taken.

	Paris feet.			Suppoſed No. of ancient Roman feet.	Deduced length of the anc. Ro. feet.
	Ft.	In.	ls.		Lines.
Width of the door of the Pantheon between the marble door-poſts	18	5	4	20	131,8
Diameter of the Pantheon on a level with the ground, between the axes of two oppoſite columns, being the mean between the NE. SW. and NW. SE. columns, differing 2 inches - - - -	137	2	0	150	131,6
Length of the Portico of the Pantheon, between the axes of the two extreme columns - - -	98	9	9	110	129,35
Height of the column called the Antonine, in the Colonna ſquare, from the top of the capital to the plinth of the baſe - - - -	91	2	5	100	131,3
Height of the Trajan column in the ſame manner, but without the fillet - - - - - - - -	91	6	10		131,85
Length of the ſhaft of the granite column, lying on the ground near the Monte Citorio, in 1756 - -	45	6	2	50	131,8
Width of the Facade of the Diocleſian baths, by M. Moreau, of the academy of Architecture -	761	6	0	840	130,5
The ſide of the ſame baths, by the ſame - - - - - - - - -	444	4	6	490	130,5
Length of the inſide of the ſtate-room of the ſame baths, now the church of the Carthuſians, by Mr Moreau and M. des Godets, on a mean - - - - - - -	180	9	1	200	
The longeſt internal dimenſion of the circumference of the Diocleſian baths, taken on the ſide of the Theatre - - - - - - -	1069	0	2	1175 1180	131,0 130,5
The ſame in the baths of Caracalla	1191	0	0	1320	129,9
The mean Length of the ancient Roman Foot - - -					130,9
Allowing 420 ancient Feet to the Diameter of the Theatre of Marcellus, which des Godets found 378 Paris Feet, the Roman Foot will come out - - - - -					130,1

INDEX.

ACademy of Sciences of Naples. Page 120
Academy of Sculpture and Painting at Rome.
Agat and Gemms wrought in hollow and in relief 11
Agneſi, Signora, profeſſor of Mathematics at Milan 164
Albano its Lake. 108
Ambroſian Library at Milan 172
Analomy, a female Profeſſor thereof. 164
Animals and Flowers repreſented by Gemms. 11
Antique Plan of Rome 56 &c.
Antiquities of Herculaneum explained. 120
Antonine's and Trajan's Pillars meaſured 73
Appennine, a chain of volcanos 110
Art of inlaying Stones. 38
Author, Plan of his intended Relation, 1 &c.
——Co-operated with P. Ximenes in the examination and reſtoration of the anc. Gnomon at Flor. 42 &c.
——Depoſited French Standard Meaſures at Florence and Rome 44
——Meaſured the Columns of Trajan and Antonine 73
——Viſited the *Grotto del Lani* 90, &c.
——Viſited Mount Veſuvio 93, &c.
——His experiments of the Pendulum at Rome 132
——Admit. at hon. memb. of the Inſtitue at Bologna 144
—— His Project for meaſuring a Deg. of Long. 158, &c.
Baillu, Chevalier, his Cabinet of Nat. Hiſtory 24
Bologna, its Inſtitute of Sciences 144
——The Author admitted an honorary Member 145
——Its Library, Cabinets and Antiquities 164
Campagna at Rome, its Air bad 74
——Marſhy, &c. 75
Carara Marble, its excellence 22
Carthaginian Mole, an Animal like a Squirrel 28
Caſcade at Terni 154
Caſino at Bologna 166
Cennis, Mount 176
——Meaſured by the Author 178
Church of St. Peter at Rome 146, &c.
Clocks abſurdly regulated in moſt parts of Italy 134

Columns

Columns of Trajan and Antonine their dimenſ. page 73
Compariſons of the Roman and Paris Foot 51
Degrees of Long. as well as Lat. ſhould be meaſ. 157
——The Author's Project for doing it 158, &c.
Dial, antique, a ſilver one, found at Herculaneum 89
Donati, Signr. his Cabinet of Nat. Hiſt. at Turin 176
Eclipſe of the Moon obſerved at Piſa 29
Emeralds, ſome Account of them 18, &c.
Emperor's Cabinet 24
——His keen Taſte for Nat. Hiſt. 25
Flowers and Fruits repreſented in relief by Gemms 25
Foot, the Pariſian and Roman compared 51
Froſt between 1755 and 1756, ſharper in the North than in the South of France 3
Gallery of Medici and its Collections. 35
Genoa, a vaſe there pretended to be Emerald 15, &c.
Ginori, Marquis, Writing on Earths, Stones, Minerals and Foſſils 25
——His Porcelane Manufactory of Florence 26
Gnomon, immenſe one at Florence deſcribed 40, &c.
Grotto del Cani viſited by the Author 90
——Experiments made there 91
Gulph of Specia, the fineſt harb. in the Mediterr. 22
Gun-powder, Experiments on it at Turin 174
Herculaneum built on Lava 103
——Ancient MSS. found there 81
——And Family Utenſils 82
——Gold Tiſſu 85
Januarius, St. his Feaſt. 120
——Liquifaction of his Blood 121
—— counterfeited ib.
Jaw Bone of an Elephant petrified 27
Inca's *Looking-Glaſſes*, a kind of Pyrites 10
——Mines of it in Germany ib.
Inoculation of the Small-pox in vogue in many parts of Italy 126
Inſtitute of Sciences at Bologna 144
Lake of Albano 108
Lava of Veſuvius 96, &c,

Lava, Naples paved with it page 101
——And the Highways to Rome, &c. 102
—— Foundation of the ancient Herculaneum 103
Laura Baſſi, Signora, Profeſſor of Anatomy 164
Leghorn, Hiſtory and Account of 24
Leo X. reſtored the Splendor of Rome, and the Salubrity of its Air 78
Leonardo da Vinci 172
Loretto, the Author's Obſervations there 136
Luna, an ancient City 22
Machines 147
Mair, Father, his Obſervations 133
Manufacture of vegetable Silk 119
Manuſcripts ancient found at Herculaneum 82
Marble of Carara, its excellence 22
Marble Edifices, numerous in Italy 11
Margravine of Bareith, her Talents 9
Marſigli, Count, Founder of the Inſt. at Bologna 144
Meaſures of ſeveral ancient Monuments at Rome 188
Medici Gallery and its Collections 35
Milan, the Ambroſian Library there 172
Milliary Stones 7
Monte Blanco 180
Monte-Nuovo, aroſe out of the Earth in one Night 92
Mount Cenis 176
Naples paved with the Lava of Veſuvius 101
—— Academy of Sciences there 120
Opus Leſſelatum or *Muſivum* (Moſaic) 36
Pantheon, ſome parts of it meaſured by the Author 64
—— By M. Deſgodets 65
Paris Toiſe, a Standard of it depoſited by the Author at Rome and at Florence 44—45
Pendulum, its Vibrations in 24 Hours at Rome 132
St. Peter's Church at Rome, its new Decorations 37
Piſa, eclipſe of the Moon obſerved there 29
——Its inclining Tower 30
——Its Obſervatory 31
——A triennial Combat on the Great Bride there 33
Piſciarelli, its boiling Springs 92

INDEX.

Plan of Rome, an antique one page 56, &c.
Pont du guard 5
Porcelane Manufactory at Florence 26
Project for meaſuring Degrees of Long. as well as of Latitude 157
Race-horſes run without Riders at Rome 149
Rhone frozen over 2
Rings found at Herculaneum 86
Roads of France, their Elegance 6 &c.
Rocks of Slate and Marble on the Genoeſe Coaſt 22
Rome, an antique Plan of it 56, &c.
—— Literary Societies there 140
Sacro Catino, a glaſs Bowl pretended to be Emerald 12
—— Some Hiſtory of it 13, &c.
San-Severino, P. of, his Eſſay on vegetable Silk 119
Silk, a vegetable one 119
Societies, Literary, or Academies in Italy. 100
Spring of freſh Water in the middle of the Sea. 22
Standards of Paris Meaſures 44, &c.
Terni, Caſcade there 154
Thermometer obſerved at Lions 3
Torre, Father, his Hiſtory of Veſuvius 35
Toſcanelli, his immenſe Gnomon at Florence 40. &c.
Trajan's and Antonine's Columns meaſured by the Author 73
Tuſcany abounds in Minerals and Foſſils 25
Tybur, its Bed raiſed by ruins 76
Vaſe at Genoa, pretended to be Emerald 15, &c.
Veloet at Venice 167
Venuti, Abbé 29
Veſuvius viſited by the Author 93
—— Its Lava 96, &c.
Ximenes, Father, his Book on the Gnomon at Florence. 41
—— Commiſſioned to make a map of Tuſcany, and meaſure an Arc of the Meridian 163

The END.